DRAINAGE REPORT
FOR
DETENTION BASIN NO. 1
INDEX NUMBERS ST-896811 & P-901793

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WOOD / PATEL ASSOCIATES
Civil Engineers
Hydrologists
Land Surveyors

DRAINAGE REPORT
FOR
DETENTION BASIN NO. 1
INDEX NUMBERS ST-896811 & P-901793

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July 1991
October 4, 1991
WP JOB NO. 90541

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1.0 INTRODUCTION

The City of Phoenix Architectural & Engineering Services Division entered into an agreement with Wood, Patel & Associates (formerly Wood & Associates) under Contract Number 55862 in May of 1990. The contract services included design and preparation of plans and specifications for the project referred to as Detention Basin No. 1, Index Numbers ST-896811 and P-901793. Detention Basin No. 1 is an approximate 22-acre parcel of land located north of Beardsley Road between 26th Street and 28th Street in the City of Phoenix (see Location Map, Figure 1). The project was initiated as a recommended drainage solution for the Upper East Fork Cave Creek Area Drainage Master Study sponsored by the Flood Control District of Maricopa County.

The Upper East Fork of Cave Creek Wash Area is an approximate 15 square mile watershed (see Figure 2). Past reports have recommended drainage solutions based on stormwater problems in the area. Detention Basin No. 1 is part of the recommended drainage solution. The project is located to collect stormwater runoff from the Upper East Fork of Cave Creek Wash and detain the runoff for a short period of time while controlling the release of stormwater flows back into the Upper East Fork of Cave Creek Wash. In conjunction with the construction of Detention Basin No. 1, downstream channel improvements to the Upper East Fork of Cave Creek Wash will be constructed. These channel improvements will convey stormwater to Detention Basin Nos. 3A and 3B located at Grovers Avenue between 20th Street and Cave Creek Road. In addition, street improvements to Beardsley Road will be constructed to remove the existing dip crossing by releasing stormwater flows through a pipe culvert (see Figure 3).

1.0 INTRODUCTION (Continued)

Detention Basin No. 1 has been designed to provide the community with a system which functions as a flood protection facility and as a recreational park facility. The basin/park facility will be integrated into the City of Phoenix Parks, Recreation and Library Department's program (see Figure 4). This will provide a mechanism for maintenance and operation of the facility before, during and after flooding events. The basin/park was master planned based on results of the park development process which included public involvement.

During development of the master plan, sediment and debris issues were addressed. This issue was resolved by including an approximate 2.5 acre parcel of land to be developed to minimize maintenance and operation to the basin/park facility (see Figure 3). The sediment basin is located upstream of the basin/park facility. The sediment basin, as well as the Beardsley Road pipe culvert crossing will be maintained and operated by the City of Phoenix Streets and Transportation Division.

The proposed Outer Loop Highway will be constructed along the north boundary of the basin/park and the sediment basin (see Figure 5). It is unknown when construction of the highway will begin but coordination with this project has been dynamic and has resulted in an acceptable design for the integration of these projects. In addition, the City of Phoenix is sponsoring construction of Cave Creek Road street improvements, a regional sanitary sewerline within the basin/park and sediment basin facilities, and several waterline and sewerline utilities in Beardsley Road. All of these projects have required extensive coordination with proposed improvements in the area.

1.0 INTRODUCTION (Continued)

During development of the basin/park, the Flood Control District of Maricopa County requested the design of a local drainage problem be addressed. Presently, this local drainage location has no outflow condition nor does it have an easement for downstream drainage conveyance. Therefore, a storm drain pipe in Beardsley Road was designed to alleviate the stormwater problems in this area by collecting the 100-year flows and conveying them to the pipe culvert crossing proposed in Beardsley Road.

Finally, it should be noted that concern for the construction of numerous projects and contractors in the area resulted in the need to provide rough grading of Detention Basin No. 1. A rough grading plan was prepared after the park master plan was developed to protect construction activity in the area (see Figure 6).

2.0 PAST REPORTS

A comprehensive drainage study sponsored by the Flood Control District of Maricopa County was completed in 1988. The Upper East Fork Cave Creek Area Drainage Master Study's purpose was to identify stormwater problems in the area and to develop solutions to these problems. The study recommended development of a system of detention basins within the area and channel improvements to the Upper East Fork of Cave Creek Wash. In addition to providing the community with flood protection, the system could be used for recreational parks and trails.

The City of Phoenix and the Flood Control District of Maricopa County sponsored a study, completed in 1989, to develop design criteria for the recommended detention basins. The design criteria addressed basin geometry, basin inflow and outflow structures and basin hydrologic and hydraulic computer modeling.

2.0 PAST REPORTS (Continued)

The City of Phoenix and the Flood Control District of Maricopa County sponsored a study, completed in 1989, to develop design criteria for a two-year storm drain pipe system within the area. The study prepared hydrologic computer modeling and included the detention basins designed for stormwater generated from a 100-year event. Storm pipe diameters and alignments were also prepared for this study.

The Arizona Department of Transportation sponsored a drainage study for the design of the proposed Outer Loop Highway completed in 1987. Results of this study indicated that coordination with the highway design was required. The hydrology and drainage concept design of this study were revised in 1990.

These studies and reports have been used as a foundation for preparation of contract documents to construct the Detention Basin No. 1 project.

3.0 TOPOGRAPHIC FEATURES

The approximate 1.3 square mile upstream watershed contributing stormwater runoff to the basin/park facility consists of several small mobile home developments, but the majority of the area is undeveloped natural desert terrain. The Central Arizona Project Canal (CAP) defines the watershed's north and east boundary which significantly reduced the area contributing runoff. Ground cover within the watershed is natural vegetation. Once rainfall generates runoff, it travels to the Upper East Fork of Cave Creek Wash which historically traversed through the basin/park parcel southeasterly to its ultimate confluence with Cave Creek Wash.

3.0 TOPOGRAPHIC FEATURES (Continued)

The proposed Outer Loop Highway will be constructed along the north boundary of Detention Basin No. 1. In addition, Beardsley Road improvements are presently under construction and include an outlet structure which will drain the basin within 36 hours. It should also be noted that rough grading of Detention Basin No. 1 is presently under construction. Excess material will be transported to the Buffalo Ridge Park located within the watershed. The design of Detention Basin No. 1 was based on ultimate development within the watershed.

4.0 HYDROLOGY

The Soil Conservation Services' TR-20 hydrologic computer model was used to determine stormwater flow characteristics within the watershed. The computer model prepared in past reports was revised to reflect current and future projects contributing runoff to the basin/park outlet structure in Beardsley Road. Contributing Drainage Subareas are depicted on Figure 7. Subarea and routing data were tabulated for the approximate 1.3 square mile contributing watershed and are included in Appendix A of this report. Figure 8 depicts the TR-20 schematic. In addition, the revised TR-20 model is included in Appendix A.

The following is a summary of the basin condition during a 100-year storm event.

5.0 DETENTION BASIN FUNCTIONING

With the exception of subareas 8 and 9, the drainage from the entire watershed enters the sedimentation basin at the northwest corner as depicted on Figure 7. Generally, most of the flow enters at the northwest corner of the sediment basin. Eventually, at this location, ADOT is proposing to put a large box culvert across the Pima Freeway. The flow from the area north of the Pima Freeway alignment, and east of the sediment basin, will enter through a proposed 72-inch pipe located at the north east corner of the sediment basin. Therefore, essentially all the sediments together, with all nuisance flow from the entire watershed, will enter into the sediment basin. (See Figure 3 for Drainage Scheme)

As the flow enters into the basin, it travels southerly through and then enters into the 60-inch diversion pipe inlet. The pipe is designed in such a way that flow up to 150 cfs will be allowed to first enter into the pipe and will be diverted through the 60-inch pipe to follow the westerly boundary of the detention basin to Beardsley Road and then along Beardsley Road easterly to connect into the existing two 48-inch pipes through a junction box. Eventually, this flow is outletted into the drainage channel south of Beardsley Road, which is being designed by NBS Lowry. Therefore, with this drainage scheme, essentially all the nuisance flow and flow up to the one-year event is bypassed around the detention basin and park. This will enhance keeping all the nuisance flow, debris and sediment out of the park system and thereby reduce maintenance of the park substantially.

5.0 DETENTION BASIN FUNCTIONING (Continued)

When the inflow value in the sediment basin is increased to more than 150 cfs, the runoff will overtop an 80 foot spillway and enter at the northwest corner of the detention basin through the spillway channel. Up to a six-foot depth of water will be stored in the sediment basin before the spillway occurs. The six-foot depth of storage contained behind the spillway in the sediment basin will thus allow the transmission velocity to reduce to significantly less than 1 foot per second. Because of this, a large portion of incoming sediments will be allowed to settle in the sediment basin. Information on sediment calculations, as well as potential of deposition and maintenance requirements, is addressed in Appendix IV.

Once the flow enters the detention basin, it spreads out in the basin bottom area covered with grass. Also, at this point, some of the flow from subareas 8 and 9 enters either by a sheet flow or by the 36-inch conduit which is located along the north side of Beardsley Road from the east of the outlet culverts.

Because of the large size and tremendous volume available in the detention basin, the flow will significantly be reduced as it is released through the two 48-inch culverts. Accordingly, this basin reduces the inflow value of about 1023 cfs to about 247 cfs through the two-48-inch pipe outlet. It is estimated that a flooding depth of about 8 feet will occur in the basin in the 100-year storm event.

5.0 DETENTION BASIN FUNCTIONING (Continued)

The easterly 48-inch pipe culvert has a constriction at the inlet face because of the reduced opening of 36-inches. This was necessitated for two reasons: (1) to control the outlet so that the downstream condition meets the requirement by the District's drainage channel system, and (2) subarea number 9 drains to Beardsley Road. An inlet is provided at Beardsley Road east of the basin which allows the flow to enter into the proposed 36-inch pipe. The pipe flows westerly along Beardsley Road and connects with the eastern most 48-inch pipe culvert. Since the invert of the 48-inch pipe culvert, at the junction, is similar to the detention basin bottom elevation, there was a concern that some of the flow may enter into the basin and pond into the bottom for all nuisance flow events. To prevent this, the invert of the 48-inch pipe was raised by 6-inches by providing a 36-inch opening at the inlet face. The outlet rating curve calculations reflect a culvert with one 48-inch pipe and the second pipe with a reduced opening (36-inch).

In general, the system is designed to meet the ultimate need by the Pima Freeway drainage system. To allow that, an interim channel is provided along the north property line. The channel collects the flow from subarea 7 at the mid point along the north property line and diverts it westerly into the sediment basin. In accordance with the input from City of Phoenix staff, the channel is designed to handle at least the 10-year storm event. Provision has been made to have the 100-year capacity within the freeboard. Since the freeway will be built in the near future, a system such as this will be adequate to handle the majority of flow occurring from all the rain events up to a 10-year storm.

5.0 DETENTION BASIN FUNCTIONING (Continued)

In the ultimate condition, with the ADOT's freeway improvements, the flows from subareas 10, 144, 9 north, and 7 will be diverted along the ADOT's north right-of-way alignment. The 72" pipe proposed at the northeast corner of sediment basin will be extended north across the freeway to intercept all diverted flow. This scheme has been coordinated with the ADOT, Flood Control District of Maricopa County and City staff. Additionally, this scheme is consistent with the Upper East Fork of Cave Creek Area Wide Drainage Master Plan.

At the northwest corner of the sediment basin, at the future outlet of the ADOT box culvert, an interim spillway is provided. The spillway allows flow to be collected from its natural channel section and safely carried to a large vertical drop into the basin bottom. Since the proposed channel has a small capacity as compared with the 100-year storm event, this particular spillway is designed to handle more frequent flows up to a 2-year storm event. This approach is appropriate because of the interim nature of the spillway. It was discussed and subsequently accepted by the City staff.

6.0 HYDRAULICS

The hydraulic computations for the drainage system are included in Appendix II. These computations were provided to substantiate the design for the project drainage system. The system is designed based on normal engineering practice together with the City of Phoenix requirements.

It should be noted that the basin bottom is provided with a network of catch basins and storm drains. This network was included to enhance drainage for all the nuisance and irrigation flows. No computations have been included for the nuisance flow estimates.

why

7.0 DETENTION BASIN VOLUME

The detention basin volume was sized in accordance with past reports. The final analysis reflects the grades shown on the final design plans. The elevation and volume relationship is shown in Appendix III of this report. This relationship was used in hydrologic computer modeling to model storage routing through the detention basin.

8.0 SEDIMENT ANALYSIS

Several options to address the sediment and debris issue associated with the design of Detention Basin No. 1 were evaluated. This evaluation resulted in a proposed sediment basin included in the design plans.

The functioning of the sediment basin is explained previously in Section 5.0 "Detention Basin Functioning".

8.0 SEDIMENT ANALYSIS (Continued)

The sediment analysis is included in Appendix IV. The results of this analysis are summarized as follows:

1. Sediment production rate/yield is anticipated to be about 0.2 Ac. Ft./sq. mile/year based on a full urbanized condition.

   The rate will be impacted due to construction activity, antecedent moisture condition, and a condition of drainage conveyance system.

2. Sediment basin is anticipated to be very effective for more frequent flows generally occurring during low moisture conditions within the drainage area.

   e.g. 1-year, 2-year, 5-year Storms

   For storm events such as 10-year, 25-year, 50-year and 100-year some sediments including:

   Fine sand
   Silt
   Clay

   will be trapped by the basin park. However, since these are less frequent events, impact to the park will be very moderate on a long term basis.

3. Sediment basin should be cleared on a 5-year basis or immediately after a major storm event (Precip. > 1.5" - 2"), whichever occurs first.

9.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the hydrologic study and design of Detention Basin No. 1, the following conclusions have been made:

1. The design of Detention Basin No. 1 is consistent with the recommendations from the Upper East Fork Cave Creek Area Drainage Master Study.

2. The basin/park provides a separate sedimentation basin to enhance sedimentation/debris collection for essentially the entire watershed area. The sediment basin will reduce sedimentation and siltation of the basin/park area significantly.

3. A diversion of the initial flow of up to 150 cfs is provided from the sedimentation basin. This diversion will reduce offsite flow from entering the basin. It is estimated that the diversion will effectively be diverting all nuisance and more frequent storm events occurring (up to 15 events) on a yearly basis. Only one event may possibly overtop the spillway and impact the basin/park facility. Consequently, significant reduction of maintenance is anticipated for the park area.

4. The sediment basin will be required to be cleared on a 5-year basis or immediately after a major storm event, which ever occurs first.

5. The spillway outlet form the sediment basin is lined with grass-crete. It is recommended that to insure its effectiveness, a good growth of grass be maintained.

6. The entire drainage system is designed to function efficiently and without any manual effort. However, to insure its adequate functioning, a periodic inspection and maintenance is recommended.

7. A catch basin/pipe network is provided in the basin/park bottom to drain the nuisance and irrigation flows. Because the pipe slopes are very minimal, a periodic inspection is recommended. This will insure that adequate conveyance is maintained.

APPENDIX I

HYDROLOGIC DATA

SUBAREA DATA

DRAINAGE AREA NO.	AREA (SQ. MI.)	CURVE NO.	TIME OF CONCENTRATION (HRS.)
* 1	.148	95	0.30
* 2	.097	95	0.19
* 3	.047	77	0.36
* 4 north of OLH	.170	95	0.22
* 5 north of OLH	.075	77	0.56
* 6	.109	81	0.82
* 19	.022	95	0.167
4 south of OLH	.025	95	0.26
5 south of OLH	.050	77	0.31
* 18	.184	78	0.72
* 8	.131	78	0.75
10	.032	77	0.29
144	.039	79	0.43
9 north of OLH	.035	79	0.42
7	.117	77	0.57
9 south of OLH	.031	79	0.38

* Taken from NBS/Lowry Report.

ROUTING DATA

DRAINAGE AREA NO.	A	L	Q	X	M	DESCRIPTION
* 3		1000	245	0.04	1.66	1 to 3
* 3		1400	159	0.04	1.66	2 to 3
* 6		1600	443			3 to 6
** 8	144	450	550	0.18	1.61	6 to 8
* 5	64	1400	283	0.61	1.48	4 to 5 N of OLH
** 8	72	1200	360	0.48	1.55	5 to 8 N of OLH
* 4	50	1200	34	0.05	1.66	19 to 4
** 5	64	1300	65	0.14	1.48	4 to 5 S of OLH
** 8	28.3	1100	115	1.76	1.25	5 to 8 S of OLH
** 144	64	1400	26	0.05	1.48	10 to 144
** 9	64	600	58	0.11	1.48	144 to 9
** 7	64	2000	82	0.16	1.48	9 to 7 N of OLH
** 8	28.3	300	167	2.56	1.25	7 to 8
8	7.1	400	167	14.41	1.25	8 to Desilting Basin
8	200	400	1178	0.02	1.66	Desilting Basin
* 8	50	1900	147	0.04	1.66	18 to Reservoir
14	7.1	1200	35	3.02	1.25	9 to Channel

* Taken from NBS/Lowry Report.
** Taken from Deleuw-Cather Report

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SUMMARY TABLE 2	PAGES 14-15
SUMMARY TABLE 3	PAGES 16-17

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 8         .107        .120        .140        .170        .500
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 8                     1505.2      289.0       78.5
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 8                     1496.7      302.7       140.5
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**********80-80 LIST OF INPUT DATA (CONTINUED)**********

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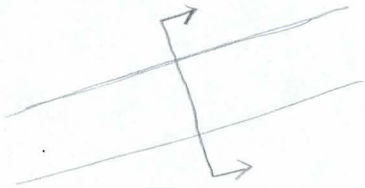
3 STRUCT        37
8                       1446.0      0.0         0.0
8                       1448.0      0.1         2.59
```



**********80-80 LIST OF INPUT DATA (CONTINUED)**********

```
8                    1448.5      110.        3.52
8                    1449.0      320.        4.45
8                    1449.5      580.        5.38
8                    1450.0      900.        6.32
9 ENDTBL
3 STRUCT      43
8                    1423.0      0.          0.
8                    1424.0      11.         0.04
8                    1425.0      50.         0.28
8                    1426.0      144.        0.72
8                    1427.0      234.        1.36
8                    1428.0      315.        2.51
8                    1429.0      390.        5.38
8                    1430.0      445.        11.43
8                    1431.0      495.        19.53
8                    1432.0      540.        28.19
8                    1433.0      585.        37.25
8                    1434.0      625.        46.73
8                    1435.0      660.        56.70
8                    1436.0      690.        67.55
8                    1437.0      720.        79.23
8                    1438.0      755.        91.45
8                    1439.0      795.        104.21
8                    1440.0      840.        117.54
9 ENDTBL
3 STRUCT      44
8                    1417.       0.          0.
8                    1418.0      4.          0.03
8                    1419.0      18.         0.85
8                    1420.0      54.         5.94
8                    1421.0      89.         16.50
8                    1422.0      121.        27.84
8                    1423.0      150.        39.53
8                    1424.0      175.        51.57
8                    1425.0      200.        63.98
8                    1426.0      220.        76.75
8                    1427.0      239.        89.89
8                    1428.0      256.        103.39
8                    1429.0      273.        117.28
8                    1430.0      287.        131.57
8                    1431.0      301.        146.26
8                    1432.0      316.        161.34
9 ENDTBL
6 RUNOFF 1 001       5 .148      95.         .3
6 RUNOFF 1 002       6 .097      95.         .19
6 REACH  3 003   5   7 1000.     .04         1.66
```

**********80-80 LIST OF INPUT DATA (CONTINUED)**********

```
6 REACH  3 003   6   5 1400.       .04         1.66
6 ADDHYD 4 003   5 7 6
6 RUNOFF 1 003       5 .047        77.         .36
6 ADDHYD 4 003   5 6 7
6 REACH  3 006   7   5 1850.
6 RUNOFF 1 006       6 .109        81.         .82
6 ADDHYD 4 006   5 6 7
6 REACH  3 008   7   1 450.        .18         1.61
6 RUNOFF 1 004       5 .170        95.         .22
6 REACH  3 005   5   6 1400.       .61         1.48
6 RUNOFF 1 005       7 .075        77.         .56
6 ADDHYD 4 005   6 7 5
6 REACH  3 008   5   6 1200.       .48         1.55
6 ADDHYD 4 008   1 6 2
6 RUNOFF 1 019       5 .022        95.         .167
6 REACH  3 004   5   6 1200.       .05         1.66
6 RUNOFF 1 004       5 .025        95.         .26
6 ADDHYD 4 004   5 6 7
6 REACH  3 005   7   5 1300.       .14         1.48
6 RUNOFF 1 005       6 .050        77.         .31
6 ADDHYD 4 005   5 6 7
6 REACH  3 008   7   5 1100.       1.76        1.25
6 ADDHYD 4 008   2 5 1
6 RUNOFF 1 010       5 .032        77.         .29
6 REACH  3 144   5   6 1400.       .05         1.48
6 RUNOFF 1 144       5 .039        79.         .43
6 ADDHYD 4 144   5 6 7
6 REACH  3 009   7   5 600.        .11         1.48
6 RUNOFF 1 009       6 .035        79.         .42
6 ADDHYD 4 009   5 6 7
6 REACH  3 007   7   5 2000.       .16         1.48
6 RUNOFF 1 007       6 .117        77.         .57
6 ADDHYD 4 007   5 6 7
6 REACH  3 008   7   5 300.        2.56        1.25
6 REACH  3 008   5   6 400.        1.          1.4
6 ADDHYD 4 008   1 6 5
6 RESVOR 2 00909 5   6 1490.5                              1 1 1 1
6 DIVERT 6 014   6 2 5 150.                    8.
6 RUNOFF 1 008       6 .131        78.         .75
6 ADDHYD 4 008   5 6 1
6 RUNOFF 1 018       5 .184        78.         .72
6 REACH  3 008   5   6 1900.       .04         1.66
6 ADDHYD 4 008   1 6 7
6 RUNOFF 1 009       5 .031        79.         .38
6 REACH  3 014   5   6 1200.       3.02        1.25
6 ADDHYD 4 008   7 6 5
```

**********80-80 LIST OF INPUT DATA (CONTINUED)**********

```
6 RESVOR 2    08 5   6 1487.84                          1 1 1 1
6 ADDHYD 4 014   2 6 4
6 REACH  3 014   4   5 3000.       .22         1.48
6 RUNOFF 1 016       6 .119        86.         .54
6 REACH  3 015   6   7 1300.       .54         1.54
6 RUNOFF 1 015       6 .073        82.         .89
6 ADDHYD 4 015   6 7 4
6 ADDHYD 4 014   4 5 7
6 RUNOFF 1 014       5 .177        83.         .39
6 ADDHYD 4 014   5 7 6
6 RUNOFF 1 010       4 .063        77.         .51
6 REACH  3 011   4   5 2640.       .44         1.54
6 RUNOFF 1 011       7 .125        79.         .84
6 ADDHYD 4 011   5 7 4
6 REACH  3 013   4   5 1320.       1.80        1.67
6 RUNOFF 1 013       7 .125        82.         .61
6 ADDHYD 4 013   5 7 4
6 RUNOFF 1 144       5 .093        79.         .44
6 REACH  3 014   5   7 2640.       2.1         1.5
6 ADDHYD 4 013   4 7 5
6 REACH  3 014   5   7 1320.       1.64        1.67
6 ADDHYD 4 014   6 7 5
6 REACH  3 027   5   7 3000.       .11         1.57
6 RUNOFF 1 027       5 .188        82.         1.2
6 ADDHYD 4 027   5 7 6
6 RUNOFF 1 017       5 .059        95.         .17
6 REACH  3 025   5   7 2200.       .05         1.66
6 RUNOFF 1 025       5 .089        83.         .43
6 ADDHYD 4 025   5 7 4
6 REACH  3 027   4   5 1700.       .11         1.57
6 ADDHYD 4 027   5 6 7
6 RUNOFF 1 026       6 .067        85.         .31
6 ADDHYD 4 027   6 7 5
6 RUNOFF 1 024       6 .198        86.         .46
6 DIVERT 6 024   6 7 1 53.                     037.
6 REACH  3 026   7   6 1500.       3.78        1.25
6 ADDHYD 4 027   6 5 3
6 RUNOFF 1 028       5 .156        82.         .93
6 DIVERT 6 028   5 7 2 21.                     036.
6 REACH  3 027   7   5 2500.       4.41        1.25
6 ADDHYD 4 027   5 3 7
6 REACH  3 037   7   4 3000.
6 RUNOFF 1 037       5 .125        83.         .25
6 ADDHYD 4 037   4 5 6
6 RESVOR 2    37 6   4 1446.0
6 REACH  3 037   1   6 2100.       .21         1.54
```

**********80-80 LIST OF INPUT DATA (CONTINUED)**********

```
6 ADDHYD 4 037   4 6 5
6 REACH  3 036   2   6 3500.       .06         1.66
6 RUNOFF 1 036       4 .125        83.         .48
6 ADDHYD 4 036   4 6 7
6 RUNOFF 1 034       4 .125        84.         .73
6 REACH  3 035   4   6 1320.       .32         1.54
6 RUNOFF 1 035       4 .125        83.         .49
6 ADDHYD 4 035   4 6 3
6 REACH  3 036   3   4 1320.       4.48        1.25
6 ADDHYD 4 036   4 7 6
6 REACH  3 037   6   7 1320.       4.64        1.25
6 ADDHYD 4 037   5 7 4
6 RUNOFF 1 143       5 .0625       85.         .53
6 ADDHYD 4 143   5 4 7
6 DIVERT 6 144   7 4 6 206.                    143.
6 RESVOR 2    43 6   5 1423.0
6 RESVOR 2    44 5   7 1417.0
6 ADDHYD 4 144   7 4 6
6 REACH  3 085   6   7 1320.       5.6         1.25
6 RUNOFF 1 085       6 .063        84.         .52
6 ADDHYD 4 085   6 7 5
6 REACH  3 084   5   6 1320.       5.6         1.25
6 RUNOFF 1 084       5 .063        84.         .52
6 ADDHYD 4 084   5 6 3
6 RUNOFF 1 091       6 .125        86.         .47
6 REACH  3 090   6   5 1320.       .22         1.54
6 RUNOFF 1 090       6 .109        85.         .63
6 ADDHYD 4 090   5 6 4
6 REACH  3 088   4   7 1320.       .22         1.54
6 RUNOFF 1 089       4 .047        84.         .39
6 REACH  3 088   4   5 2000.       .22         1.54
6 RUNOFF 1 088       4 .094        87.         .75
6 ADDHYD 4 088   4 5 6
6 ADDHYD 4 088   6 7 5
6 DIVERT 6 088   5 7 2 159.                    101.
6 REACH  3 084   7   6 2640.       2.78        1.25
6 DIVERT 6 084   3 4 1             .35         83.
6 ADDHYD 4 084   4 6 5
6 REACH  3 105   5   3 1320.       6.1         1.25
6 REACH  3 101   2   5 1050.       .22         1.54
6 RUNOFF 1 101       6 .047        89.         .52
6 ADDHYD 4 101   5 6 7
6 REACH  3 102   7   6 1320.       .02         1.66
6 RUNOFF 1 102       5 .063        82.         .63
6 ADDHYD 4 102   5 6 7
6 REACH  3 105   7   6 1320.
```

**********80-80 LIST OF INPUT DATA (CONTINUED)**********

```
6 RUNOFF 1 105       5 .063        78.         .63
6 ADDHYD 4 105   5 6 2
6 RUNOFF 1 086       5 .063        86.         .27
6 REACH  3 087   5   6 1320.
6 RUNOFF 1 087       5 .063        87.         .52
6 ADDHYD 4 087   5 6 7
6 REACH  3 105   7   6 2000.
6 ADDHYD 4 105   3 6 7
6 ADDHYD 4 105   7 2 5
6 REACH  3 104   5   6 1320.       6.1         1.25
6 RUNOFF 1 104       5 .069        78.         .67
6 ADDHYD 4 104   5 6 3
6 REACH  3 083   1   5 1320.       7.6         1.25
6 RUNOFF 1 083       6 .063        85.         .52
6 ADDHYD 4 083   5 6 7
6 REACH  3 106   7   6 1320.       7.1         1.25
6 RUNOFF 1 106       5 .063        79.         .56
6 ADDHYD 4 106   5 6 7
6 REACH  3 107   7   6 900.        7.1         1.25
6 RUNOFF 1 107       5 .059        82.         .42
6 ADDHYD 4 107   5 6 1
  ENDATA
7 INCREM 6             .08
7 COMPUT 7 001   016               1.44        24.         1 2  01  01
  ENDCMP 1
7 COMPUT 7 001   016               2.53        24.         1 2  01  02
  ENDCMP 1
7 COMPUT 7 001   016               4.04        24.         1 2  01  03
  ENDCMP 1
  ENDJOB 2
```

**********END OF 80-80 LIST**********

COMPUTER PROGRAM FOR PROJECT FORMULATION - HYDROLOGY USER NOTES

THE USERS MANUAL FOR THIS PROGRAM IS THE MAY 1982 DRAFT OF TR-20. CHANGES FROM THE 2/14/74 VERSION INCLUDE:

REACH ROUTING - THE MODIFIED ATT-KIN ROUTING PROCEDURE REPLACES THE CONVEX METHOD. INPUT DATA PREPARED FOR PREVIOUS PROGRAM VERSIONS USING CONVEX ROUTING COEFFICIENTS WILL NOT RUN ON THIS VERSION.

THE PREFERRED TYPE OF DATA ENTRY IS CROSS SECTION DATA REPRESENTATIVE OF A REACH. IT IS RECOMMENDED THAT THE OPTIONAL CROSS SECTION DISCHARGE-AREA PLOTS BE OBTAINED WHENEVER NEW CROSS SECTION DATA IS ENTERED. THE PLOTS SHOULD BE CHECKED FOR REASONABLENESS AND ADEQUACY OF INPUT DATA FOR THE COMPUTATION OF "M" VALUES USED IN THE ROUTING PROCEDURE.

GUIDELINES FOR DETERMINING OR ANALYZING REACH LENGTHS AND COEFFICIENTS (X,M) ARE AVAILABLE IN THE USERS MANUAL. SUMMARY TABLE 2 DISPLAYS REACH ROUTING RESULTS AND ROUTING PARAMETERS FOR COMPARISON AND CHECKING.

HYDROGRAPH GENERATION - THE PROCEDURE TO CALCULATE THE INTERNAL TIME INCREMENT AND PEAK TIME OF THE UNIT HYDROGRAPH HAVE BEEN IMPROVED. PEAK DISCHARGES AND TIMES MAY DIFFER FROM THE PREVIOUS VERSION. OUTPUT HYDROGRAPHS ARE STILL INTERPOLATED, PRINTED, AND ROUTED AT THE USER SELECTED MAIN TIME INCREMENT.

INTERMEDIATE PEAKS - METHOD ADDED TO PROVIDE DISCHARGES AT INTERMEDIATE POINTS WITHIN REACHES WITHOUT ROUTING.

OTHER - THIS VERSION CONTAINS SOME ADDITIONS TO THE INPUT AND NUMEROUS MODIFICATIONS TO THE OUTPUT. USER OPTIONS HAVE BEEN MODIFIED AND AUGMENTED ON THE JOB RECORD, RAINTABLES ADDED, ERROR AND WARNING MESSAGES EXPANDED, AND THE SUMMARY TABLES COMPLETELY REVISED. THE HOLDOUT OPTION IS NOT OPERATIONAL AT THIS TIME.

PROGRAM QUESTIONS OR PROBLEMS SHOULD BE DIRECTED TO HYDRAULIC ENGINEERS AT THE SCS NATIONAL TECHNICAL CENTERS:

CHESTER, PA (NORTHEAST) -- 215-499-3933, FORT WORTH, TX (SOUTH) -- 334-5242 (FTS)
LINCOLN, NB (MIDWEST) -- 541-5318 (FTS), PORTLAND, OR (WEST) -- 423-4099 (FTS)
OR HYDROLOGY UNIT, ENGINEERING DIVISION, LANHAM, MD -- 436-7383 (FTS).

PROGRAM CHANGES SINCE MAY 1982:

12/17/82 - CORRECT PEAK RATE FACTOR FOR USER ENTERED DIMHYD
CORRECT REACH ROUTING PEAK TRAVEL TIME PRINTED WITH FULLPRINT OPTION
5/02/83 - CORRECT COMPUTATIONS FOR ---
1. DIVISION OF BASEFLOW IN DIVERT OPERATION
2. HYDROGRAPH VOLUME SPLIT BETWEEN BASEFLOW AND ABOVE BASEFLOW
3. CROSS SECTION DATA PLOTTING POSITION
4. INTERMEDIATE PEAK WHEN "FROM" AREA IS LARGER THAN "THRU" AREA
5. STORAGE ROUTED REACH TRAVEL TIME FOR MULTIPEAK HYDROGRAPH
6. ORDERING "FLOW-FREQ" FILE FROM SUMMARY TABLE #3 DATA
7. BASEFLOW ENTERED WITH READHYD
8. LOW FLOW SPLIT DURING DIVERT PROCEDURE #2 WHEN SECTION RATINGS START AT DIFFERENT ELEVATIONS
ENHANCEMENTS ---
1. REPLACE USER MANUAL ERROR CODES (PAGE 4-9 TO 4-11) WITH MESSAGES
2. LABEL OUTPUT HYDROGRAPH FILES WITH CROSS SECTION/STRUCTURE, ALTERNATE AND STORM NO'S
09/01/83 - CORRECT INPUT AND OUTPUT ERRORS FOR INTERMEDIATE PEAKS
CORRECT COMBINATION OF RATING TABLES FOR DIVERT
CHECK REACH ROUTING PARAMETERS FOR ACCEPTABLE LIMITS
ELIMINATE MINIMUM REACH TRAVEL TIME WHEN ATT-KIN COEFFICIENT EQUALS ONE

EXECUTIVE CONTROL OPERATION INCREM MAIN TIME INCREMENT = 0.08 HOURS RECORD ID

EXECUTIVE CONTROL OPERATION COMPUT FROM XSECTION 1 TO XSECTION 16 RECORD ID
STARTING TIME = 0.00 RAIN DEPTH = 1.44 RAIN DURATION= 24.00 RAIN TABLE NO.= 1 ANT. MOIST. COND= 2
ALTERNATE NO.= 1 STORM NO.= 1 MAIN TIME INCREMENT = 0.08 HOURS

*** WARNING REACH 8 ATT-KIN COEFF.(C) GREATER THAN 0.667, CONSIDER REDUCING MAIN TIME INCREMENT ***

*** WARNING REACH 8 ATT-KIN COEFF.(C) GREATER THAN 0.667, CONSIDER REDUCING MAIN TIME INCREMENT ***

*** WARNING REACH 144 LENGTH FACTOR (K*) GREATER THAN 1.0, CONSIDER DIVIDING REACH LENGTH ***

*** WARNING-NO PEAK FOUND, MAXIMUM DISCHARGE = 0.82 CFS.

*** WARNING REACH 8 ATT-KIN COEFF.(C) GREATER THAN 0.667, CONSIDER REDUCING MAIN TIME INCREMENT ***

*** WARNING REACH 8 ATT-KIN COEFF.(C) GREATER THAN 0.667, CONSIDER REDUCING MAIN TIME INCREMENT ***

OPERATION RESVOR CROSS SECTION 9

OPERATION RESVOR STRUCTURE 9

PEAK TIME(HRS)	PEAK DISCHARGE(CFS)	PEAK ELEVATION(FEET)
12.93	199.48	(NULL)

TIME(HRS) FIRST HYDROGRAPH POINT = 0.00 HOURS TIME INCREMENT = 0.08 HOURS DRAINAGE AREA = 0.97 SQ.MI.

8.80	DISCHG	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.03	0.04
9.60	DISCHG	0.06	0.08	0.10	0.13	0.17	0.21	0.25	0.30	0.35	0.41
10.40	DISCHG	0.46	0.52	0.59	0.65	0.72	0.79	0.87	0.96	1.06	1.18
11.20	DISCHG	1.30	1.43	1.59	1.76	1.96	2.18	2.44	2.90	3.91	5.79
12.00	DISCHG	8.65	12.54	17.48	23.45	35.55	50.43	70.05	91.27	111.50	128.59
12.80	DISCHG	140.91	195.20	197.33	174.45	159.64	141.06	136.84	132.27	126.80	119.33
13.60	DISCHG	111.07	102.96	94.69	86.61	79.07	72.35	66.46	61.03	56.06	51.55
14.40	DISCHG	47.99	45.02	42.29	39.78	37.49	35.40	33.49	31.73	30.14	28.67
15.20	DISCHG	27.32	26.04	24.88	24.22	23.52	22.80	22.07	21.32	20.58	19.85
16.00	DISCHG	19.13	18.44	17.76	17.12	16.50	15.91	15.36	14.84	14.34	13.88
16.80	DISCHG	13.44	13.01	12.60	12.21	11.84	11.48	11.14	10.82	10.52	10.24
17.60	DISCHG	9.99	9.75	9.52	9.32	9.12	8.94	8.77	8.61	8.46	8.31
18.40	DISCHG	8.16	8.01	7.87	7.72	7.59	7.46	7.34	7.23	7.13	7.04
19.20	DISCHG	6.96	6.88	6.80	6.72	6.65	6.57	6.49	6.41	6.33	6.25
20.00	DISCHG	6.18	6.10	6.03	5.97	5.91	5.87	5.83	5.80	5.78	5.76
20.80	DISCHG	5.74	5.72	5.70	5.67	5.64	5.61	5.58	5.56	5.54	5.53
21.60	DISCHG	5.52	5.52	5.52	5.52	5.51	5.49	5.48	5.46	5.44	5.42
22.40	DISCHG	5.41	5.40	5.40	5.40	5.41	5.41	5.41	5.41	5.40	5.38
23.20	DISCHG	5.37	5.35	5.32	5.30	5.28	5.25	5.23	5.21	5.20	5.19

RUNOFF VOLUME ABOVE BASEFLOW = 0.55 WATERSHED INCHES, 342.86 CFS-HRS, 28.33 ACRE-FEET; BASEFLOW = 0.00 CFS

***WARNING - LACK OF LOW FLOW DEFINITION FOR XSECT TABLE 14. MAX.FLOW LESS THAN 2ND TABLE VALUE.

OPERATION RESVOR STRUCTURE 8

PEAK TIME(HRS)	PEAK DISCHARGE(CFS)	PEAK ELEVATION(FEET)
13.88	11.16	1489.22

TIME(HRS) FIRST HYDROGRAPH POINT = 0.00 HOURS TIME INCREMENT = 0.08 HOURS DRAINAGE AREA = 1.31 SQ.MI.

11.20	DISCHG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
11.20	ELEV	1487.84	1487.84	1487.84	1487.84	1487.84	1487.84	1487.84	1487.84	1487.84	1487.84
12.00	DISCHG	0.06	0.24	0.66	1.05	1.19	1.43	1.78	2.25	2.81	3.45
12.00	ELEV	1487.85	1487.88	1487.95	1488.01	1488.03	1488.07	1488.13	1488.21	1488.30	1488.41
12.80	DISCHG	4.09	5.70	7.89	9.29	10.04	10.38	10.54	10.69	10.82	10.93
12.80	ELEV	1488.52	1488.78	1489.05	1489.12	1489.16	1489.18	1489.19	1489.19	1489.20	1489.21
13.60	DISCHG	11.03	11.09	11.14	11.16	11.16	11.14	11.10	11.04	10.96	10.87
13.60	ELEV	1489.21	1489.22	1489.22	1489.22	1489.22	1489.22	1489.22	1489.21	1489.21	1489.20
14.40	DISCHG	10.77	10.66	10.54	10.42	10.28	10.15	10.00	9.86	9.71	9.55
14.40	ELEV	1489.20	1489.19	1489.19	1489.18	1489.17	1489.17	1489.16	1489.15	1489.14	1489.13
15.20	DISCHG	9.40	9.24	9.08	8.92	8.76	8.59	8.42	8.25	8.08	7.91
15.20	ELEV	1489.13	1489.12	1489.11	1489.10	1489.09	1489.08	1489.07	1489.07	1489.06	1489.05
16.00	DISCHG	7.74	7.58	7.41	7.24	7.08	6.89	6.67	6.46	6.25	6.05
16.00	ELEV	1489.04	1489.03	1489.02	1489.01	1489.00	1488.98	1488.94	1488.91	1488.87	1488.84
16.80	DISCHG	5.85	5.66	5.48	5.30	5.13	4.96	4.80	4.65	4.50	4.36
16.80	ELEV	1488.81	1488.78	1488.75	1488.72	1488.69	1488.66	1488.63	1488.61	1488.58	1488.56
17.60	DISCHG	4.23	4.10	3.97	3.86	3.74	3.63	3.53	3.43	3.33	3.24
17.60	ELEV	1488.54	1488.52	1488.50	1488.48	1488.46	1488.44	1488.42	1488.40	1488.39	1488.37
18.40	DISCHG	3.15	3.06	2.98	2.90	2.83	2.75	2.68	2.62	2.56	2.50
18.40	ELEV	1488.36	1488.34	1488.33	1488.32	1488.30	1488.29	1488.28	1488.27	1488.26	1488.25
19.20	DISCHG	2.44	2.38	2.33	2.28	2.23	2.18	2.14	2.09	2.05	2.01
19.20	ELEV	1488.24	1488.23	1488.22	1488.21	1488.20	1488.20	1488.19	1488.18	1488.17	1488.17
20.00	DISCHG	1.97	1.93	1.89	1.86	1.83	1.79	1.77	1.74	1.71	1.69
20.00	ELEV	1488.16	1488.16	1488.15	1488.14	1488.14	1488.13	1488.13	1488.12	1488.12	1488.11
20.80	DISCHG	1.66	1.64	1.62	1.60	1.58	1.56	1.54	1.52	1.51	1.49
20.80	ELEV	1488.11	1488.11	1488.10	1488.10	1488.10	1488.09	1488.09	1488.09	1488.08	1488.08
21.60	DISCHG	1.48	1.46	1.45	1.44	1.43	1.42	1.40	1.39	1.38	1.37
21.60	ELEV	1488.08	1488.08	1488.08	1488.07	1488.07	1488.07	1488.07	1488.07	1488.06	1488.06
22.40	DISCHG	1.36	1.36	1.35	1.34	1.34	1.33	1.32	1.32	1.31	1.30
22.40	ELEV	1488.06	1488.06	1488.06	1488.06	1488.06	1488.05	1488.05	1488.05	1488.05	1488.05
23.20	DISCHG	1.30	1.29	1.28	1.28	1.27	1.27	1.26	1.25	1.25	1.25
23.20	ELEV	1488.05	1488.05	1488.05	1488.05	1488.05	1488.04	1488.04	1488.04	1488.04	1488.04

RUNOFF VOLUME ABOVE BASEFLOW = 0.06 WATERSHED INCHES, 54.83 CFS-HRS, 4.53 ACRE-FEET; BASEFLOW = 0.00 CFS

EXECUTIVE CONTROL OPERATION ENDCMP COMPUTATIONS COMPLETED FOR PASS 1 RECORD ID

EXECUTIVE CONTROL OPERATION COMPUT FROM XSECTION 1 TO XSECTION 16 RECORD ID
STARTING TIME = 0.00 RAIN DEPTH = 2.53 RAIN DURATION= 24.00 RAIN TABLE NO.= 1 ANT. MOIST. COND= 2
ALTERNATE NO.= 1 STORM NO.= 2 MAIN TIME INCREMENT = 0.08 HOURS

*** WARNING REACH 8 ATT-KIN COEFF.(C) GREATER THAN 0.667, CONSIDER REDUCING MAIN TIME INCREMENT ***

*** WARNING REACH 5 ATT-KIN COEFF.(C) GREATER THAN 0.667, CONSIDER REDUCING MAIN TIME INCREMENT ***

*** WARNING REACH 8 ATT-KIN COEFF.(C) GREATER THAN 0.667, CONSIDER REDUCING MAIN TIME INCREMENT ***

*** WARNING REACH 8 ATT-KIN COEFF.(C) GREATER THAN 0.667, CONSIDER REDUCING MAIN TIME INCREMENT ***

*** WARNING REACH 144 LENGTH FACTOR (K*) GREATER THAN 1.0, CONSIDER DIVIDING REACH LENGTH ***

*** WARNING REACH 8 ATT-KIN COEFF.(C) GREATER THAN 0.667, CONSIDER REDUCING MAIN TIME INCREMENT ***

*** WARNING REACH 8 ATT-KIN COEFF.(C) GREATER THAN 0.667, CONSIDER REDUCING MAIN TIME INCREMENT ***

OPERATION RESVOR CROSS SECTION 9

OPERATION RESVOR STRUCTURE 9

PEAK TIME(HRS)	PEAK DISCHARGE(CFS)	PEAK ELEVATION(FEET)
12.70	603.75	(NULL)

TIME(HRS) FIRST HYDROGRAPH POINT = 0.00 HOURS TIME INCREMENT = 0.08 HOURS DRAINAGE AREA = 0.97 SQ.MI.

4.80	DISCHG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
5.60	DISCHG	0.02	0.03	0.04	0.05	0.06	0.08	0.09	0.11	0.13	0.15
6.40	DISCHG	0.18	0.20	0.22	0.24	0.27	0.29	0.32	0.34	0.37	0.40
7.20	DISCHG	0.44	0.47	0.50	0.53	0.56	0.59	0.62	0.65	0.68	0.71
8.00	DISCHG	0.74	0.78	0.81	0.85	0.89	0.92	0.95	0.98	1.01	1.04
8.80	DISCHG	1.07	1.10	1.13	1.16	1.20	1.24	1.29	1.36	1.46	1.59
9.60	DISCHG	1.74	1.90	2.09	2.29	2.51	2.73	2.96	3.20	3.45	3.69
10.40	DISCHG	3.93	4.16	4.39	4.62	4.84	5.08	5.35	5.65	5.98	6.34
11.20	DISCHG	6.73	7.15	7.64	8.19	8.81	9.47	10.26	11.79	15.23	21.41
12.00	DISCHG	35.94	61.57	97.94	133.13	337.72	474.36	520.15	559.95	591.37	603.07
12.80	DISCHG	577.05	517.83	448.04	379.94	318.40	265.99	222.50	186.86	166.17	148.59
13.60	DISCHG	138.37	134.80	130.40	125.41	118.38	111.19	104.18	97.24	90.39	84.13
14.40	DISCHG	78.48	73.55	69.41	65.68	62.32	59.30	56.56	54.07	51.82	49.82
15.20	DISCHG	48.29	46.71	44.98	43.10	41.10	39.04	36.95	34.90	32.91	31.01
16.00	DISCHG	29.22	27.54	25.99	24.78	24.11	23.47	22.88	22.32	21.79	21.29
16.80	DISCHG	20.81	20.34	19.87	19.42	18.98	18.55	18.14	17.76	17.42	17.10
17.60	DISCHG	16.81	16.55	16.31	16.08	15.88	15.69	15.50	15.33	15.17	15.00
18.40	DISCHG	14.82	14.64	14.45	14.26	14.07	13.90	13.74	13.61	13.50	13.40
19.20	DISCHG	13.31	13.23	13.14	13.04	12.94	12.82	12.71	12.59	12.47	12.36
20.00	DISCHG	12.24	12.13	12.03	11.93	11.86	11.80	11.77	11.75	11.74	11.74
20.80	DISCHG	11.74	11.72	11.70	11.66	11.62	11.57	11.53	11.50	11.49	11.48
21.60	DISCHG	11.50	11.51	11.53	11.54	11.53	11.52	11.49	11.45	11.42	11.39

22.40	DISCHG	11.38	11.38	11.40	11.42	11.45	11.47	11.47	11.47	11.45	11.42
23.20	DISCHG	11.38	11.34	11.30	11.25	11.20	11.15	11.11	11.07	11.05	11.05

RUNOFF VOLUME ABOVE BASEFLOW = 1.34 WATERSHED INCHES, 834.52 CFS-HRS, 68.97 ACRE-FEET; BASEFLOW = 0.00 CFS

*** WARNING REACH 14 ATT-KIN COEFF.(C) GREATER THAN 0.667, CONSIDER REDUCING MAIN TIME INCREMENT ***

OPERATION RESVOR STRUCTURE 8

PEAK TIME(HRS)	PEAK DISCHARGE(CFS)	PEAK ELEVATION(FEET)
13.31	133.05	1492.22

TIME(HRS) FIRST HYDROGRAPH POINT = 0.00 HOURS TIME INCREMENT = 0.08 HOURS DRAINAGE AREA = 1.31 SQ.MI.

11.20	DISCHG	0.00	0.00	0.00	0.00	0.00	0.01	0.05	0.25	0.87	1.13
11.20	ELEV	1487.84	1487.84	1487.84	1487.84	1487.84	1487.84	1487.85	1487.88	1487.98	1488.02
12.00	DISCHG	1.44	1.99	2.83	4.03	8.95	18.28	32.25	50.86	70.67	87.22
12.00	ELEV	1488.07	1488.16	1488.31	1488.50	1489.10	1489.59	1490.12	1490.46	1490.83	1491.16
12.80	DISCHG	100.05	111.32	120.39	126.61	130.07	132.13	132.99	132.84	131.97	130.58
12.80	ELEV	1491.45	1491.70	1491.90	1492.04	1492.14	1492.19	1492.22	1492.21	1492.19	1492.15
13.60	DISCHG	128.93	127.20	125.40	123.07	120.55	118.00	115.44	112.87	110.30	107.75
13.60	ELEV	1492.11	1492.06	1492.01	1491.96	1491.90	1491.84	1491.79	1491.73	1491.67	1491.62
14.40	DISCHG	105.22	102.72	100.25	97.82	95.44	93.10	90.80	88.56	86.37	84.22
14.40	ELEV	1491.56	1491.50	1491.45	1491.40	1491.34	1491.29	1491.24	1491.19	1491.14	1491.09
15.20	DISCHG	82.13	80.08	77.08	74.15	71.31	68.57	65.93	63.38	60.92	58.54
15.20	ELEV	1491.05	1491.00	1490.95	1490.89	1490.84	1490.79	1490.74	1490.69	1490.65	1490.60
16.00	DISCHG	56.25	54.04	51.92	49.87	47.91	46.02	44.20	42.47	40.80	39.20
16.00	ELEV	1490.56	1490.52	1490.48	1490.44	1490.41	1490.37	1490.34	1490.30	1490.27	1490.24
16.80	DISCHG	37.66	36.19	34.78	33.43	32.13	30.89	29.70	28.56	27.47	26.43
16.80	ELEV	1490.22	1490.19	1490.16	1490.14	1490.11	1490.09	1490.07	1490.05	1490.03	1490.01
17.60	DISCHG	25.59	24.89	24.21	23.56	22.93	22.31	21.72	21.15	20.59	20.06
17.60	ELEV	1489.98	1489.94	1489.91	1489.87	1489.84	1489.81	1489.77	1489.74	1489.72	1489.69
18.40	DISCHG	19.53	19.03	18.53	18.06	17.59	17.14	16.71	16.29	15.88	15.48
18.40	ELEV	1489.66	1489.63	1489.61	1489.58	1489.56	1489.53	1489.51	1489.49	1489.47	1489.45
19.20	DISCHG	15.10	14.73	14.37	14.03	13.69	13.36	13.04	12.73	12.43	12.14
19.20	ELEV	1489.43	1489.41	1489.39	1489.37	1489.35	1489.33	1489.32	1489.30	1489.29	1489.27
20.00	DISCHG	11.85	11.58	11.31	11.05	10.80	10.56	10.33	10.10	9.89	9.68
20.00	ELEV	1489.26	1489.24	1489.23	1489.21	1489.20	1489.19	1489.18	1489.16	1489.15	1489.14
20.80	DISCHG	9.48	9.28	9.09	8.91	8.73	8.55	8.39	8.22	8.07	7.92
20.80	ELEV	1489.13	1489.12	1489.11	1489.10	1489.09	1489.08	1489.07	1489.06	1489.06	1489.05
21.60	DISCHG	7.77	7.63	7.50	7.36	7.24	7.11	6.99	6.82	6.67	6.51
21.60	ELEV	1489.04	1489.03	1489.03	1489.02	1489.01	1489.01	1489.00	1488.97	1488.94	1488.92
22.40	DISCHG	6.37	6.24	6.11	5.98	5.87	5.76	5.65	5.55	5.45	5.35
22.40	ELEV	1488.90	1488.87	1488.85	1488.83	1488.81	1488.79	1488.77	1488.76	1488.74	1488.72
23.20	DISCHG	5.26	5.17	5.08	4.99	4.91	4.83	4.75	4.68	4.61	4.55
23.20	ELEV	1488.71	1488.69	1488.68	1488.67	1488.65	1488.64	1488.63	1488.61	1488.60	1488.59

RUNOFF VOLUME ABOVE BASEFLOW = 0.57 WATERSHED INCHES, 485.03 CFS-HRS, 40.08 ACRE-FEET; BASEFLOW = 0.00 CFS

EXECUTIVE CONTROL OPERATION ENDCMP COMPUTATIONS COMPLETED FOR PASS 2 RECORD ID

EXECUTIVE CONTROL OPERATION COMPUT FROM XSECTION 1 TO XSECTION 16 RECORD ID
STARTING TIME = 0.00 RAIN DEPTH = 4.04 RAIN DURATION= 24.00 RAIN TABLE NO.= 1 ANT. MOIST. COND= 2
ALTERNATE NO.= 1 STORM NO.= 3 MAIN TIME INCREMENT = 0.08 HOURS

*** WARNING REACH 8 ATT-KIN COEFF.(C) GREATER THAN 0.667, CONSIDER REDUCING MAIN TIME INCREMENT ***

*** WARNING REACH 5 ATT-KIN COEFF.(C) GREATER THAN 0.667, CONSIDER REDUCING MAIN TIME INCREMENT ***

*** WARNING REACH 8 ATT-KIN COEFF.(C) GREATER THAN 0.667, CONSIDER REDUCING MAIN TIME INCREMENT ***

*** WARNING REACH 8 ATT-KIN COEFF.(C) GREATER THAN 0.667, CONSIDER REDUCING MAIN TIME INCREMENT ***

*** WARNING REACH 8 ATT-KIN COEFF.(C) GREATER THAN 0.667, CONSIDER REDUCING MAIN TIME INCREMENT ***

*** WARNING REACH 8 ATT-KIN COEFF.(C) GREATER THAN 0.667, CONSIDER REDUCING MAIN TIME INCREMENT ***

OPERATION RESVOR CROSS SECTION 9

OPERATION RESVOR STRUCTURE 9

PEAK TIME(HRS)	PEAK DISCHARGE(CFS)	PEAK ELEVATION(FEET)
12.67	1170.46	(NULL)

TIME(HRS) FIRST HYDROGRAPH POINT = 0.00 HOURS TIME INCREMENT = 0.08 HOURS DRAINAGE AREA = 0.97 SQ.MI.

3.20	DISCHG	0.00	0.00	0.00	0.00	0.01	0.02	0.03	0.05	0.07	0.10
4.00	DISCHG	0.13	0.16	0.19	0.23	0.27	0.32	0.37	0.42	0.48	0.55
4.80	DISCHG	0.61	0.68	0.74	0.81	0.87	0.93	0.99	1.05	1.11	1.17
5.60	DISCHG	1.22	1.28	1.34	1.41	1.48	1.55	1.63	1.72	1.80	1.89
6.40	DISCHG	1.97	2.04	2.11	2.17	2.24	2.30	2.37	2.44	2.51	2.59
7.20	DISCHG	2.68	2.76	2.84	2.91	2.98	3.04	3.09	3.15	3.20	3.26
8.00	DISCHG	3.33	3.40	3.48	3.56	3.63	3.70	3.76	3.82	3.86	3.91
8.80	DISCHG	3.95	4.00	4.06	4.12	4.19	4.27	4.38	4.57	4.83	5.16
9.60	DISCHG	5.55	5.99	6.47	6.98	7.52	8.07	8.62	9.18	9.74	10.28
10.40	DISCHG	10.81	11.31	11.79	12.26	12.71	13.20	13.76	14.40	15.10	15.86
11.20	DISCHG	16.67	17.58	18.62	19.82	21.16	22.68	24.68	32.58	50.07	87.64
12.00	DISCHG	134.86	500.79	695.48	806.93	905.75	1009.29	1072.46	1130.22	1167.91	1160.52
12.80	DISCHG	1072.26	931.16	810.54	682.07	562.54	462.83	381.54	316.41	265.94	227.40
13.60	DISCHG	197.83	175.72	164.11	149.58	139.13	136.37	132.87	128.90	124.56	118.82
14.40	DISCHG	113.38	108.30	103.61	99.25	94.96	91.08	87.53	84.30	81.34	78.63
15.20	DISCHG	76.03	73.40	70.47	67.14	63.55	59.80	56.04	52.36	49.09	46.45
16.00	DISCHG	43.94	41.58	39.40	37.41	35.62	34.05	32.68	31.48	30.43	29.49
16.80	DISCHG	28.62	27.80	27.00	26.24	25.52	24.92	24.61	24.33	24.09	23.89
17.60	DISCHG	23.72	23.58	23.46	23.35	23.26	23.18	23.11	23.04	22.97	22.88

18.40	DISCHG	22.76	22.61	22.45	22.27	22.10	21.94	21.81	21.72	21.65	21.60
19.20	DISCHG	21.57	21.53	21.48	21.40	21.30	21.19	21.06	20.93	20.79	20.65
20.00	DISCHG	20.51	20.38	20.25	20.14	20.06	20.02	20.01	20.03	20.07	20.11
20.80	DISCHG	20.15	20.16	20.15	20.11	20.06	20.00	19.95	19.93	19.93	19.96
21.60	DISCHG	20.01	20.06	20.12	20.15	20.15	20.13	20.09	20.04	19.99	19.95
22.40	DISCHG	19.95	19.96	20.00	20.06	20.12	20.16	20.18	20.17	20.14	20.09
23.20	DISCHG	20.03	19.95	19.87	19.79	19.70	19.62	19.54	19.49	19.46	19.47

RUNOFF VOLUME ABOVE BASEFLOW = 2.61 WATERSHED INCHES, 1624.66 CFS-HRS, 134.26 ACRE-FEET; BASEFLOW = 0.00 CFS

*** WARNING REACH 14 ATT-KIN COEFF.(C) GREATER THAN 0.667, CONSIDER REDUCING MAIN TIME INCREMENT ***

OPERATION RESVOR STRUCTURE 8

PEAK TIME(HRS)	PEAK DISCHARGE(CFS)	PEAK ELEVATION(FEET)
13.44	249.74	1496.36

TIME(HRS) FIRST HYDROGRAPH POINT = 0.00 HOURS TIME INCREMENT = 0.08 HOURS DRAINAGE AREA = 1.31 SQ.MI.

10.40	DISCHG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
10.40	ELEV	1487.84	1487.84	1487.84	1487.84	1487.84	1487.84	1487.84	1487.84	1487.84	1487.84
11.20	DISCHG	0.02	0.05	0.11	0.21	0.38	0.76	1.08	1.36	1.98	3.12
11.20	ELEV	1487.84	1487.85	1487.86	1487.87	1487.90	1487.96	1488.01	1488.06	1488.16	1488.35
12.00	DISCHG	4.95	12.93	30.60	60.11	89.30	114.61	138.07	160.32	177.80	194.36
12.00	ELEV	1488.66	1489.31	1490.09	1490.63	1491.21	1491.77	1492.35	1492.95	1493.54	1494.13
12.80	DISCHG	207.97	219.71	229.25	236.89	242.44	245.99	248.25	249.43	249.74	249.35
12.80	ELEV	1494.68	1495.15	1495.53	1495.84	1496.06	1496.21	1496.30	1496.35	1496.36	1496.35
13.60	DISCHG	248.41	247.05	245.39	243.49	241.44	239.11	236.68	234.22	231.73	229.23
13.60	ELEV	1496.31	1496.25	1496.18	1496.10	1496.02	1495.92	1495.83	1495.73	1495.63	1495.53
14.40	DISCHG	226.72	224.22	221.72	219.23	216.76	214.26	211.74	209.25	206.79	204.35
14.40	ELEV	1495.43	1495.33	1495.23	1495.13	1495.03	1494.93	1494.83	1494.73	1494.63	1494.53
15.20	DISCHG	201.94	199.55	197.17	194.81	192.47	189.97	187.20	184.45	181.74	179.05
15.20	ELEV	1494.44	1494.34	1494.25	1494.15	1494.06	1493.96	1493.87	1493.77	1493.68	1493.59
16.00	DISCHG	176.39	173.77	171.17	168.61	166.09	163.60	160.84	157.55	154.32	151.16
16.00	ELEV	1493.50	1493.41	1493.32	1493.23	1493.14	1493.06	1492.97	1492.88	1492.79	1492.71
16.80	DISCHG	148.07	145.04	142.07	139.17	136.33	133.54	130.82	128.15	125.54	122.33
16.80	ELEV	1492.62	1492.54	1492.46	1492.38	1492.31	1492.23	1492.16	1492.09	1492.01	1491.94
17.60	DISCHG	119.03	115.82	112.71	109.70	106.76	103.92	101.15	98.47	95.86	93.33
17.60	ELEV	1491.87	1491.80	1491.73	1491.66	1491.59	1491.53	1491.47	1491.41	1491.35	1491.30
18.40	DISCHG	90.86	88.46	86.13	83.86	81.66	79.27	76.13	73.13	70.26	67.51
18.40	ELEV	1491.24	1491.19	1491.14	1491.09	1491.04	1490.99	1490.93	1490.87	1490.82	1490.77
19.20	DISCHG	64.89	62.38	59.97	57.67	55.46	53.35	51.32	49.38	47.52	45.73
19.20	ELEV	1490.72	1490.67	1490.63	1490.59	1490.55	1490.51	1490.47	1490.43	1490.40	1490.37
20.00	DISCHG	44.02	42.38	40.81	39.31	37.88	36.51	35.20	33.95	32.77	31.63
20.00	ELEV	1490.33	1490.30	1490.27	1490.25	1490.22	1490.19	1490.17	1490.15	1490.13	1490.10
20.80	DISCHG	30.55	29.51	28.51	27.56	26.65	25.83	25.22	24.63	24.05	23.50
20.80	ELEV	1490.08	1490.06	1490.05	1490.03	1490.01	1489.99	1489.96	1489.93	1489.90	1489.87
21.60	DISCHG	22.97	22.45	21.96	21.47	21.00	20.55	20.11	19.68	19.26	18.85
21.60	ELEV	1489.84	1489.81	1489.79	1489.76	1489.74	1489.71	1489.69	1489.67	1489.65	1489.62

22.40	DISCHG	18.46	18.08	17.72	17.37	17.03	16.70	16.39	16.08	15.78	15.48
22.40	ELEV	1489.60	1489.58	1489.56	1489.55	1489.53	1489.51	1489.49	1489.48	1489.46	1489.45
23.20	DISCHG	15.19	14.91	14.64	14.37	14.11	13.86	13.61	13.37	13.14	12.92
23.20	ELEV	1489.43	1489.42	1489.40	1489.39	1489.37	1489.36	1489.35	1489.34	1489.32	1489.31

RUNOFF VOLUME ABOVE BASEFLOW = 1.55 WATERSHED INCHES, 1310.40 CFS-HRS, 108.29 ACRE-FEET; BASEFLOW = 0.00 CFS

EXECUTIVE CONTROL OPERATION ENDCMP COMPUTATIONS COMPLETED FOR PASS 3 RECORD ID

EXECUTIVE CONTROL OPERATION ENDJOB RECORD ID

SUMMARY TABLE 1 - SELECTED RESULTS OF STANDARD AND EXECUTIVE CONTROL INSTRUCTIONS IN THE ORDER PERFORMED
(A STAR(*) AFTER THE PEAK DISCHARGE TIME AND RATE (CFS) VALUES INDICATES A FLAT TOP HYDROGRAPH
A QUESTION MARK(?) INDICATES A HYDROGRAPH WITH PEAK AS LAST POINT.)

SECTION/ STRUCTURE ID	STANDARD CONTROL OPERATION	DRAINAGE AREA (SQ MI)	RAIN TABLE #	ANTEC MOIST COND	MAIN TIME INCREM (HR)	PRECIPITATION BEGIN (HR)	PRECIPITATION AMOUNT (IN)	PRECIPITATION DURATION (HR)	RUNOFF AMOUNT (IN)	PEAK DISCHARGE ELEVATION (FT)	PEAK DISCHARGE TIME (HR)	PEAK DISCHARGE RATE (CFS)	PEAK DISCHARGE RATE (CSM)
ALTERNATE 1 STORM 1													
XSECTION 1	RUNOFF	0.15	1	2	0.08	0.0	1.44	24.00	0.95	---	12.47	77.45	523.3
XSECTION 2	RUNOFF	0.10	1	2	0.08	0.0	1.44	24.00	0.95	---	12.45	52.48	541.0
XSECTION 3	REACH	0.15	1	2	0.08	0.0	1.44	24.00	0.95	---	12.69	72.61	490.6
XSECTION 3	REACH	0.10	1	2	0.08	0.0	1.44	24.00	0.95	---	12.83	44.46	458.4
XSECTION 3	ADDHYD	0.25	1	2	0.08	0.0	1.44	24.00	0.95	---	12.72	114.58	467.7
XSECTION 3	RUNOFF	0.05	1	2	0.08	0.0	1.44	24.00	0.18	---	12.57	5.96	126.8
XSECTION 3	ADDHYD	0.29	1	2	0.08	0.0	1.44	24.00	0.82	---	12.71	118.91	407.2
XSECTION 6	REACH	0.29	1	2	0.08	0.0	1.44	24.00	0.82	1504.48	12.85	114.61	392.5
XSECTION 6	RUNOFF	0.11	1	2	0.08	0.0	1.44	24.00	0.28	---	12.80	14.02	128.7
XSECTION 6	ADDHYD	0.40	1	2	0.08	0.0	1.44	24.00	0.68	1504.56	12.84	128.46	320.4
XSECTION 8	REACH	0.40	1	2	0.08	0.0	1.44	24.00	0.68	1495.58	12.84	128.46	320.4
XSECTION 4	RUNOFF	0.17	1	2	0.08	0.0	1.44	24.00	0.95	---	12.45	90.92	534.8
XSECTION 5	REACH	0.17	1	2	0.08	0.0	1.44	24.00	0.95	---	12.54	89.46	526.2
XSECTION 5	RUNOFF	0.08	1	2	0.08	0.0	1.44	24.00	0.18	---	12.67	7.61	101.5
XSECTION 5	ADDHYD	0.25	1	2	0.08	0.0	1.44	24.00	0.72	---	12.55	96.11	392.3
XSECTION 8	REACH	0.25	1	2	0.08	0.0	1.44	24.00	0.72	1495.33	12.64	94.93	387.5
XSECTION 8	ADDHYD	0.65	1	2	0.08	0.0	1.44	24.00	0.69	1496.49	12.70	215.01	332.8
XSECTION 19	RUNOFF	0.02	1	2	0.08	0.0	1.44	24.00	0.96	---	12.44	12.02	546.5
XSECTION 4	REACH	0.02	1	2	0.08	0.0	1.44	24.00	0.94	---	12.92	9.33	424.1
XSECTION 4	RUNOFF	0.03	1	2	0.08	0.0	1.44	24.00	0.95	---	12.46	13.24	529.5
XSECTION 4	ADDHYD	0.05	1	2	0.08	0.0	1.44	24.00	0.95	---	12.51	19.41	413.0
XSECTION 5	REACH	0.05	1	2	0.08	0.0	1.44	24.00	0.94	---	12.86	15.53	330.4
XSECTION 5	RUNOFF	0.05	1	2	0.08	0.0	1.44	24.00	0.18	---	12.55	6.76	135.1
XSECTION 5	ADDHYD	0.10	1	2	0.08	0.0	1.44	24.00	0.55	---	12.63	18.80	193.8
XSECTION 8	REACH	0.10	1	2	0.08	0.0	1.44	24.00	0.55	1494.50	12.77	18.28	188.4
XSECTION 8	ADDHYD	0.74	1	2	0.08	0.0	1.44	24.00	0.67	1496.54	12.71	233.14	313.8
XSECTION 10	RUNOFF	0.03	1	2	0.08	0.0	1.44	24.00	0.18	---	12.54	4.40	137.6
XSECTION 144	REACH	0.03	1	2	0.08	0.0	1.44	24.00	0.16	---	14.08?	0.82?	25.8
XSECTION 144	RUNOFF	0.04	1	2	0.08	0.0	1.44	24.00	0.23	---	12.59	5.68	145.7
XSECTION 144	ADDHYD	0.07	1	2	0.08	0.0	1.44	24.00	0.20	---	12.59	5.68	80.0
XSECTION 9	REACH	0.07	1	2	0.08	0.0	1.44	24.00	0.20	---	12.88	4.21	59.3
XSECTION 9	RUNOFF	0.04	1	2	0.08	0.0	1.44	24.00	0.23	---	12.59	5.15	147.2

SUMMARY TABLE 1 - SELECTED RESULTS OF STANDARD AND EXECUTIVE CONTROL INSTRUCTIONS IN THE ORDER PERFORMED
(A STAR(*) AFTER THE PEAK DISCHARGE TIME AND RATE (CFS) VALUES INDICATES A FLAT TOP HYDROGRAPH
A QUESTION MARK(?) INDICATES A HYDROGRAPH WITH PEAK AS LAST POINT.)

SECTION/ STRUCTURE ID	STANDARD CONTROL OPERATION	DRAINAGE AREA (SQ MI)	RAIN TABLE #	ANTEC MOIST COND	MAIN TIME INCREM (HR)	PRECIPITATION BEGIN (HR)	PRECIPITATION AMOUNT (IN)	PRECIPITATION DURATION (HR)	RUNOFF AMOUNT (IN)	PEAK DISCHARGE ELEVATION (FT)	PEAK DISCHARGE TIME (HR)	PEAK DISCHARGE RATE (CFS)	PEAK DISCHARGE RATE (CSM)
ALTERNATE 1 STORM 1													
XSECTION 9	ADDHYD	0.11	1	2	0.08	0.0	1.44	24.00	0.21	---	12.67	7.92	74.8
XSECTION 7	REACH	0.11	1	2	0.08	0.0	1.44	24.00	0.20	---	13.38	4.54	42.8
XSECTION 7	RUNOFF	0.12	1	2	0.08	0.0	1.44	24.00	0.18	---	12.67	11.72	100.2
XSECTION 7	ADDHYD	0.22	1	2	0.08	0.0	1.44	24.00	0.19	---	12.71	12.82	57.5
XSECTION 8	REACH	0.22	1	2	0.08	0.0	1.44	24.00	0.19	1494.40	12.71	12.82	57.5
XSECTION 8	REACH	0.22	1	2	0.08	0.0	1.44	24.00	0.19	1494.40	12.71	12.82	57.5
XSECTION 8	ADDHYD	0.97	1	2	0.08	0.0	1.44	24.00	0.56	1496.57	12.71	245.96	254.6
XSECTION 9	RESVOR	0.97	1	2	0.08	0.0	1.44	24.00	0.55	---	12.93	199.48	206.5
XSECTION 14	DIVERT	0.00	1	2	0.08	0.0	1.44	24.00	0.55	1486.25	12.88*	150.00**********	
XSECTION 8	DIVERT	0.97	1	2	0.08	0.0	1.44	24.00	0.02	1494.92	12.93	49.48	51.2
XSECTION 8	RUNOFF	0.13	1	2	0.08	0.0	1.44	24.00	0.20	---	12.78	12.55	95.8
XSECTION 8	ADDHYD	1.10	1	2	0.08	0.0	1.44	24.00	0.04	1495.02	12.92	60.75	55.4
XSECTION 18	RUNOFF	0.18	1	2	0.08	0.0	1.44	24.00	0.20	---	12.75	18.39	100.0
XSECTION 8	REACH	0.18	1	2	0.08	0.0	1.44	24.00	0.20	1494.35	13.50	10.09	54.8
XSECTION 8	ADDHYD	1.28	1	2	0.08	0.0	1.44	24.00	0.06	1495.06	12.93	64.33	50.2
XSECTION 9	RUNOFF	0.03	1	2	0.08	0.0	1.44	24.00	0.23	---	12.57	4.77	153.9
XSECTION 14	REACH	0.03	1	2	0.08	0.0	1.44	24.00	0.23	1484.30	12.68	4.55	146.9
XSECTION 8	ADDHYD	1.31	1	2	0.08	0.0	1.44	24.00	0.07	1495.08	12.92	66.81	50.9
STRUCTURE 8	RESVOR	1.31	1	2	0.08	0.0	1.44	24.00	0.06	1489.22	13.88	11.16	8.5
XSECTION 14	ADDHYD	1.31	1	2	0.08	0.0	1.44	24.00	0.46	1486.34	13.09	160.87	122.6
XSECTION 14	REACH	1.31	1	2	0.08	0.0	1.44	24.00	0.45	1486.18	13.41	142.32	108.5
XSECTION 16	RUNOFF	0.12	1	2	0.08	0.0	1.44	24.00	0.45	---	12.61	30.00	252.1
ALTERNATE 1 STORM 2													
XSECTION 1	RUNOFF	0.15	1	2	0.08	0.0	2.53	24.00	1.98	---	12.45	149.82	1012.3
XSECTION 2	RUNOFF	0.10	1	2	0.08	0.0	2.53	24.00	1.99	---	12.44	100.45	1035.5
XSECTION 3	REACH	0.15	1	2	0.08	0.0	2.53	24.00	1.98	---	12.66	145.14	980.7
XSECTION 3	REACH	0.10	1	2	0.08	0.0	2.53	24.00	1.97	---	12.72	92.53	954.0
XSECTION 3	ADDHYD	0.25	1	2	0.08	0.0	2.53	24.00	1.98	---	12.68	238.07	971.7
XSECTION 3	RUNOFF	0.05	1	2	0.08	0.0	2.53	24.00	0.75	---	12.54	22.94	488.1
XSECTION 3	ADDHYD	0.29	1	2	0.08	0.0	2.53	24.00	1.78	---	12.63	255.59	875.3
XSECTION 6	REACH	0.29	1	2	0.08	0.0	2.53	24.00	1.78	1505.07	12.77	250.50	857.9
XSECTION 6	RUNOFF	0.11	1	2	0.08	0.0	2.53	24.00	0.95	---	12.74	48.43	444.3
XSECTION 6	ADDHYD	0.40	1	2	0.08	0.0	2.53	24.00	1.55	1505.22	12.77	298.76	745.0
XSECTION 8	REACH	0.40	1	2	0.08	0.0	2.53	24.00	1.55	1496.69	12.77	298.76	745.0
XSECTION 4	RUNOFF	0.17	1	2	0.08	0.0	2.53	24.00	1.99	---	12.44	174.55	1026.8
XSECTION 5	REACH	0.17	1	2	0.08	0.0	2.53	24.00	1.98	---	12.53	173.35	1019.7

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A QUESTION MARK(?) INDICATES A HYDROGRAPH WITH PEAK AS LAST POINT.)

SECTION/ STRUCTURE ID	STANDARD CONTROL OPERATION	DRAINAGE AREA (SQ MI)	RAIN TABLE #	ANTEC MOIST COND	MAIN TIME INCREM (HR)	PRECIPITATION BEGIN (HR)	PRECIPITATION AMOUNT (IN)	PRECIPITATION DURATION (HR)	RUNOFF AMOUNT (IN)	PEAK DISCHARGE ELEVATION (FT)	PEAK DISCHARGE TIME (HR)	PEAK DISCHARGE RATE (CFS)	PEAK DISCHARGE RATE (CSM)
ALTERNATE 1 STORM 2													
XSECTION 5	RUNOFF	0.08	1	2	0.08	0.0	2.53	24.00	0.75	---	12.62	31.48	419.7
XSECTION 5	ADDHYD	0.25	1	2	0.08	0.0	2.53	24.00	1.61	---	12.54	203.49	830.6
XSECTION 8	REACH	0.25	1	2	0.08	0.0	2.53	24.00	1.60	1496.46	12.62	202.61	827.0
XSECTION 8	ADDHYD	0.65	1	2	0.08	0.0	2.53	24.00	1.57	1496.95	12.67	491.22	760.4
XSECTION 19	RUNOFF	0.02	1	2	0.08	0.0	2.53	24.00	1.99	---	12.44	22.96	1043.8
XSECTION 4	REACH	0.02	1	2	0.08	0.0	2.53	24.00	1.97	---	12.89	19.93	905.7
XSECTION 4	RUNOFF	0.03	1	2	0.08	0.0	2.53	24.00	1.98	---	12.45	25.51	1020.3
XSECTION 4	ADDHYD	0.05	1	2	0.08	0.0	2.53	24.00	1.98	---	12.50	40.65	864.9
XSECTION 5	REACH	0.05	1	2	0.08	0.0	2.53	24.00	1.96	---	12.83	35.23	749.6
XSECTION 5	RUNOFF	0.05	1	2	0.08	0.0	2.53	24.00	0.75	---	12.52	25.34	506.8
XSECTION 5	ADDHYD	0.10	1	2	0.08	0.0	2.53	24.00	1.34	---	12.57	53.33	549.8
XSECTION 8	REACH	0.10	1	2	0.08	0.0	2.53	24.00	1.34	1494.94	12.67	52.27	538.8
XSECTION 8	ADDHYD	0.74	1	2	0.08	0.0	2.53	24.00	1.54	1497.01	12.67	543.49	731.5
XSECTION 10	RUNOFF	0.03	1	2	0.08	0.0	2.53	24.00	0.75	---	12.51	16.13	503.9
XSECTION 144	REACH	0.03	1	2	0.08	0.0	2.53	24.00	0.73	---	13.34	7.05	220.5
XSECTION 144	RUNOFF	0.04	1	2	0.08	0.0	2.53	24.00	0.85	---	12.55	20.07	514.6
XSECTION 144	ADDHYD	0.07	1	2	0.08	0.0	2.53	24.00	0.80	---	12.57	20.65	290.8
XSECTION 9	REACH	0.07	1	2	0.08	0.0	2.53	24.00	0.79	---	12.74	18.36	258.6
XSECTION 9	RUNOFF	0.04	1	2	0.08	0.0	2.53	24.00	0.85	---	12.55	18.11	517.5
XSECTION 9	ADDHYD	0.11	1	2	0.08	0.0	2.53	24.00	0.81	---	12.62	34.58	326.3
XSECTION 7	REACH	0.11	1	2	0.08	0.0	2.53	24.00	0.80	---	13.06	25.18	237.5
XSECTION 7	RUNOFF	0.12	1	2	0.08	0.0	2.53	24.00	0.75	---	12.62	48.65	415.8
XSECTION 7	ADDHYD	0.22	1	2	0.08	0.0	2.53	24.00	0.78	---	12.68	63.35	284.1
XSECTION 8	REACH	0.22	1	2	0.08	0.0	2.53	24.00	0.78	1495.05	12.68	63.35	284.1
XSECTION 8	REACH	0.22	1	2	0.08	0.0	2.53	24.00	0.78	1495.05	12.68	63.35	284.1
XSECTION 8	ADDHYD	0.97	1	2	0.08	0.0	2.53	24.00	1.36	1497.07	12.67	606.88	628.2
XSECTION 9	RESVOR	0.97	1	2	0.08	0.0	2.53	24.00	1.34	---	12.70	603.75	625.0
XSECTION 14	DIVERT	0.00	1	2	0.08	0.0	2.53	24.00	1.34	1486.25	12.32*	150.00	**********
XSECTION 8	DIVERT	0.97	1	2	0.08	0.0	2.53	24.00	0.50	1496.90	12.70	453.75	469.7
XSECTION 8	RUNOFF	0.13	1	2	0.08	0.0	2.53	24.00	0.80	---	12.71	50.85	388.2
XSECTION 8	ADDHYD	1.10	1	2	0.08	0.0	2.53	24.00	0.54	1496.97	12.71	504.58	460.0
XSECTION 18	RUNOFF	0.18	1	2	0.08	0.0	2.53	24.00	0.80	---	12.70	73.81	401.1
XSECTION 8	REACH	0.18	1	2	0.08	0.0	2.53	24.00	0.79	1494.97	13.16	55.14	299.7
XSECTION 8	ADDHYD	1.28	1	2	0.08	0.0	2.53	24.00	0.57	1497.01	12.72	534.89	417.6
XSECTION 9	RUNOFF	0.03	1	2	0.08	0.0	2.53	24.00	0.85	---	12.54	16.53	533.3
XSECTION 14	REACH	0.03	1	2	0.08	0.0	2.53	24.00	0.85	1484.63	12.63	16.28	525.1

SUMMARY TABLE 1 - SELECTED RESULTS OF STANDARD AND EXECUTIVE CONTROL INSTRUCTIONS IN THE ORDER PERFORMED
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SECTION/ STRUCTURE ID	STANDARD CONTROL OPERATION	DRAINAGE AREA (SQ MI)	RAIN TABLE #	ANTEC MOIST COND	MAIN TIME INCREM (HR)	PRECIPITATION BEGIN (HR)	PRECIPITATION AMOUNT (IN)	PRECIPITATION DURATION (HR)	RUNOFF AMOUNT (IN)	PEAK DISCHARGE ELEVATION (FT)	PEAK DISCHARGE TIME (HR)	PEAK DISCHARGE RATE (CFS)	PEAK DISCHARGE RATE (CSM)
ALTERNATE 1 STORM 2													
XSECTION 8	ADDHYD	1.31	1	2	0.08	0.0	2.53	24.00	0.58	1497.02	12.71	550.06	419.3
STRUCTURE 8	RESVOR	1.31	1	2	0.08	0.0	2.53	24.00	0.57	1492.22	13.31	133.05	101.4
XSECTION 14	ADDHYD	1.31	1	2	0.08	0.0	2.53	24.00	1.19	1487.15	13.31	283.05	215.7
XSECTION 14	REACH	1.31	1	2	0.08	0.0	2.53	24.00	1.18	1487.11	13.59	276.22	210.5
XSECTION 16	RUNOFF	0.12	1	2	0.08	0.0	2.53	24.00	1.26	---	12.57	79.99	672.2
ALTERNATE 1 STORM 3													
XSECTION 1	RUNOFF	0.15	1	2	0.08	0.0	4.04	24.00	3.46	---	12.45	248.49	1679.0
XSECTION 2	RUNOFF	0.10	1	2	0.08	0.0	4.04	24.00	3.46	---	12.44	165.73	1708.6
XSECTION 3	REACH	0.15	1	2	0.08	0.0	4.04	24.00	3.45	---	12.63	244.59	1652.7
XSECTION 3	REACH	0.10	1	2	0.08	0.0	4.04	24.00	3.44	---	12.70	158.51	1634.1
XSECTION 3	ADDHYD	0.25	1	2	0.08	0.0	4.04	24.00	3.45	---	12.65	400.78	1635.9
XSECTION 3	RUNOFF	0.05	1	2	0.08	0.0	4.04	24.00	1.83	---	12.52	51.36	1092.7
XSECTION 3	ADDHYD	0.29	1	2	0.08	0.0	4.04	24.00	3.19	---	12.59	446.92	1530.5
XSECTION 6	REACH	0.29	1	2	0.08	0.0	4.04	24.00	3.18	1505.54	12.72	441.24	1511.1
XSECTION 6	RUNOFF	0.11	1	2	0.08	0.0	4.04	24.00	2.13	---	12.71	106.85	980.3
XSECTION 6	ADDHYD	0.40	1	2	0.08	0.0	4.04	24.00	2.90	1506.06	12.71	548.07	1366.8
XSECTION 8	REACH	0.40	1	2	0.08	0.0	4.04	24.00	2.90	1497.02	12.71	548.07	1366.8
XSECTION 4	RUNOFF	0.17	1	2	0.08	0.0	4.04	24.00	3.46	---	12.44	288.39	1696.4
XSECTION 5	REACH	0.17	1	2	0.08	0.0	4.04	24.00	3.45	---	12.52	287.39	1690.5
XSECTION 5	RUNOFF	0.08	1	2	0.08	0.0	4.04	24.00	1.83	---	12.59	73.59	981.2
XSECTION 5	ADDHYD	0.25	1	2	0.08	0.0	4.04	24.00	2.96	---	12.53	359.81	1468.6
XSECTION 8	REACH	0.25	1	2	0.08	0.0	4.04	24.00	2.95	1496.78	12.61	359.51	1467.4
XSECTION 8	ADDHYD	0.65	1	2	0.08	0.0	4.04	24.00	2.92	1497.32	12.64	899.26	1392.0
XSECTION 19	RUNOFF	0.02	1	2	0.08	0.0	4.04	24.00	3.47	---	12.44	37.85	1720.5
XSECTION 4	REACH	0.02	1	2	0.08	0.0	4.04	24.00	3.44	---	12.79	34.79	1581.6
XSECTION 4	RUNOFF	0.03	1	2	0.08	0.0	4.04	24.00	3.46	---	12.44	42.22	1688.8
XSECTION 4	ADDHYD	0.05	1	2	0.08	0.0	4.04	24.00	3.45	---	12.48	72.56	1543.9
XSECTION 5	REACH	0.05	1	2	0.08	0.0	4.04	24.00	3.43	---	12.72	66.36	1411.9
XSECTION 5	RUNOFF	0.05	1	2	0.08	0.0	4.04	24.00	1.83	---	12.50	55.89	1117.8
XSECTION 5	ADDHYD	0.10	1	2	0.08	0.0	4.04	24.00	2.61	---	12.54	116.20	1198.0
XSECTION 8	REACH	0.10	1	2	0.08	0.0	4.04	24.00	2.61	1495.48	12.63	115.01	1185.7
XSECTION 8	ADDHYD	0.74	1	2	0.08	0.0	4.04	24.00	2.88	1497.39	12.64	1014.25	1365.1
XSECTION 10	RUNOFF	0.03	1	2	0.08	0.0	4.04	24.00	1.83	---	12.49	36.02	1125.7
XSECTION 144	REACH	0.03	1	2	0.08	0.0	4.04	24.00	1.80	---	13.12	22.54	704.4
XSECTION 144	RUNOFF	0.04	1	2	0.08	0.0	4.04	24.00	1.98	---	12.53	44.08	1130.3
XSECTION 144	ADDHYD	0.07	1	2	0.08	0.0	4.04	24.00	1.90	---	12.58	52.80	743.6

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(A STAR(*) AFTER THE PEAK DISCHARGE TIME AND RATE (CFS) VALUES INDICATES A FLAT TOP HYDROGRAPH
A QUESTION MARK(?) INDICATES A HYDROGRAPH WITH PEAK AS LAST POINT.)

SECTION/ STRUCTURE ID	STANDARD CONTROL OPERATION	DRAINAGE AREA (SQ MI)	RAIN TABLE #	ANTEC MOIST COND	MAIN TIME INCREM (HR)	PRECIPITATION BEGIN (HR)	PRECIPITATION AMOUNT (IN)	PRECIPITATION DURATION (HR)	RUNOFF AMOUNT (IN)	PEAK DISCHARGE ELEVATION (FT)	PEAK DISCHARGE TIME (HR)	PEAK DISCHARGE RATE (CFS)	PEAK DISCHARGE RATE (CSM)
ALTERNATE 1 STORM 3													
XSECTION 9	REACH	0.07	1	2	0.08	0.0	4.04	24.00	1.89	---	12.72	49.66	699.5
XSECTION 9	RUNOFF	0.04	1	2	0.08	0.0	4.04	24.00	1.98	---	12.53	39.73	1135.1
XSECTION 9	ADDHYD	0.11	1	2	0.08	0.0	4.04	24.00	1.92	---	12.61	84.89	800.9
XSECTION 7	REACH	0.11	1	2	0.08	0.0	4.04	24.00	1.91	---	13.00	70.40	664.1
XSECTION 7	RUNOFF	0.12	1	2	0.08	0.0	4.04	24.00	1.83	---	12.59	113.95	974.0
XSECTION 7	ADDHYD	0.22	1	2	0.08	0.0	4.04	24.00	1.87	---	12.66	161.98	726.4
XSECTION 8	REACH	0.22	1	2	0.08	0.0	4.04	24.00	1.87	1495.80	12.66	161.98	726.4
XSECTION 8	REACH	0.22	1	2	0.08	0.0	4.04	24.00	1.87	1495.80	12.66	161.98	726.4
XSECTION 8	ADDHYD	0.97	1	2	0.08	0.0	4.04	24.00	2.64	1497.49	12.64	1175.90	1217.3
XSECTION 9	RESVOR	0.97	1	2	0.08	0.0	4.04	24.00	2.61	---	12.67	1170.46	1211.7
XSECTION 14	DIVERT	0.00	1	2	0.08	0.0	4.04	24.00	2.61	1486.25	12.08*	150.00	**********
XSECTION 8	DIVERT	0.97	1	2	0.08	0.0	4.04	24.00	1.47	1497.40	12.67	1020.46	1056.4
XSECTION 8	RUNOFF	0.13	1	2	0.08	0.0	4.04	24.00	1.90	---	12.68	119.20	909.9
XSECTION 8	ADDHYD	1.10	1	2	0.08	0.0	4.04	24.00	1.52	1497.47	12.67	1139.62	1038.9
XSECTION 18	RUNOFF	0.18	1	2	0.08	0.0	4.04	24.00	1.90	---	12.67	171.98	934.7
XSECTION 8	REACH	0.18	1	2	0.08	0.0	4.04	24.00	1.89	1495.70	12.98	146.42	795.7
XSECTION 8	ADDHYD	1.28	1	2	0.08	0.0	4.04	24.00	1.57	1497.55	12.69	1256.98	981.3
XSECTION 9	RUNOFF	0.03	1	2	0.08	0.0	4.04	24.00	1.98	---	12.52	35.95	1159.8
XSECTION 14	REACH	0.03	1	2	0.08	0.0	4.04	24.00	1.98	1485.00	12.61	35.73	1152.7
XSECTION 8	ADDHYD	1.31	1	2	0.08	0.0	4.04	24.00	1.58	1497.57	12.68	1290.84	983.9
STRUCTURE 8	RESVOR	1.31	1	2	0.08	0.0	4.04	24.00	1.55	1496.36	13.44	249.74	190.3
XSECTION 14	ADDHYD	1.31	1	2	0.08	0.0	4.04	24.00	2.39	1487.75	13.44	399.74	304.7
XSECTION 14	REACH	1.31	1	2	0.08	0.0	4.04	24.00	2.38	1487.73	13.78	395.90	301.8
XSECTION 16	RUNOFF	0.12	1	2	0.08	0.0	4.04	24.00	2.56	---	12.54	155.97	1310.7

SUMMARY TABLE 2 - SELECTED MODIFIED ATT-KIN REACH ROUTINGS IN ORDER OF STANDARD EXECUTIVE CONTROL INSTRUCTIONS
(A STAR(*) AFTER VOLUME ABOVE BASE(IN) INDICATES A HYDROGRAPH TRUNCATED AT A VALUE EXCEEDING BASE + 10% OF PEAK
A QUESTION MARK(?) AFTER COEFF.(C) INDICATES PARAMETERS OUTSIDE ACCEPTABLE LIMITS, SEE PREVIOUS WARNINGS)

		HYDROGRAPH INFORMATION							ROUTING PARAMETERS										PEAK	
		INFLOW		OUTFLOW		OUTFLOW+ INTERV.AREA						Q AND A EQUATION						TRAVEL TIME	
XSEC ID	REACH LENGTH (FT)	PEAK (CFS)	TIME (HR)	PEAK (CFS)	TIME (HR)	PEAK (CFS)	TIME (HR)	BASE-FLOW (CFS)	VOLUME ABOVE BASE (IN)	MAIN TIME INCR (HR)	ITER-ATION #	COEFF (X)	POWER (M)	LENGTH FACTOR (K*)	PEAK RATIO O/I (Q*)	S/Q @PEAK (K) (SEC)	ATT-KIN COEFF (C)	STOR-AGE (HR)	KINE-MATIC (HR)
ALTERNATE		1	STORM	1															
3	1000	77	12.5	72	12.7	---	---	0	0.95	0.08	1	0.040	1.66	0.129	0.934	743	0.32	0.16	0.21
3	1400	52	12.5	44	12.8	---	---	0	0.95	0.08	1	0.040	1.66	0.303	0.857	1222	0.21	0.08	0.35
6	1850	119	12.7	114	12.9	128	12.9	0	0.82	0.08	1	1.60	1.20	0.077	0.961	466	0.47	0.16	0.13
8	450	128	12.9	128	12.9	---	---	0	0.68	0.08	0	0.180	1.61	0.006	1.000	129	1.00?	0.00	0.00
5	1400	90	12.5	89	12.6	96	12.6	0	0.95	0.08	1	0.610	1.48	0.037	0.990	307	0.64	0.08	0.09
8	1200	96	12.6	95	12.6	---	---	0	0.72	0.08	1	0.480	1.55	0.024	0.989	246	0.74?	0.08	0.07
4	1200	12	12.5	9	13.0	19	12.5	0	0.96	0.08	1	0.050	1.66	0.501	0.785	1649	0.16	0.16	0.48
5	1300	19	12.5	16	12.9	19	12.6	0	0.95	0.08	1	0.140	1.48	0.212	0.803	1269	0.20	0.24	0.36
8	1100	19	12.6	18	12.8	---	---	0	0.55	0.08	1	1.76	1.25	0.029	0.971	311	0.63	0.16	0.09
144	1400	4	12.6	1	14.1	6	12.6	0	0.18	0.08	1	0.050	1.48	3.000	0.189	7624	0.04?	0.40	1.52
9	600	6	12.6	4	12.9	8	12.6	0	0.20	0.08	1	0.110	1.48	0.138	0.747	1028	0.25	0.24	0.30
7	2000	8	12.6	5	13.4	13	12.7	0	0.21	0.08	1	0.160	1.48	0.410	0.575	2386	0.11	0.48	0.72
8	300	13	12.7	13	12.7	---	---	0	0.19	0.08	0	2.56	1.25	0.004	1.000	68	1.00?	0.00	0.00
8	400	13	12.7	13	12.7	---	---	0	0.19	0.08	0	1.00	1.40	0.006	1.000	138	1.00?	0.00	0.00
8	1900	18	12.7	10	13.5	---	---	0	0.20	0.08	1	0.040	1.66	0.797	0.552	2507	0.11	0.48	0.78
14	1200	5	12.6	5	12.6	---	---	0	0.23	0.08	1	3.02	1.25	0.060	0.944	290	0.66	0.08	0.08
14	3000	160	13.1	142	13.4	---	---	0	0.46	0.08	1	0.220	1.48	0.082	0.889	1087	0.23	0.32	0.31
ALTERNATE		1	STORM	2															
3	1000	149	12.5	145	12.6	---	---	0	1.98	0.08	1	0.040	1.66	0.074	0.971	572	0.40	0.08	0.16
3	1400	99	12.5	93	12.7	236	12.7	0	1.99	0.08	1	0.040	1.66	0.171	0.939	945	0.26	0.08	0.27
6	1850	256	12.6	250	12.8	298	12.8	0	1.78	0.08	1	1.73	1.17	0.074	0.977	438	0.49	0.16	0.12
8	450	298	12.8	298	12.8	---	---	0	1.55	0.08	0	0.180	1.61	0.004	1.000	94	1.00?	0.00	0.00
5	1400	172	12.5	172	12.6	203	12.6	0	1.99	0.08	1	0.610	1.48	0.024	0.998	249	0.73?	0.08	0.07
8	1200	203	12.6	202	12.6	---	---	0	1.61	0.08	1	0.480	1.55	0.014	0.997	189	0.87?	0.08	0.05
4	1200	22	12.5	20	12.9	41	12.5	0	1.99	0.08	1	0.050	1.66	0.282	0.890	1277	0.20	0.08	0.36
5	1300	41	12.5	35	12.8	53	12.6	0	1.98	0.08	1	0.140	1.48	0.150	0.865	998	0.25	0.16	0.28
8	1100	53	12.6	52	12.6	---	---	0	1.34	0.08	1	1.76	1.25	0.027	0.975	253	0.73?	0.08	0.07
144	1400	16	12.5	7	13.4	21	12.6	0	0.75	0.08	1	0.050	1.48	1.360	0.440	3439	0.08?	0.32	0.9
9	600	21	12.6	18	12.7	34	12.6	0	0.80	0.08	1	0.110	1.48	0.065	0.889	675	0.35	0.16	0.1
7	2000	34	12.6	25	13.0	63	12.7	0	0.81	0.08	1	0.160	1.48	0.236	0.730	1479	0.18	0.24	0.4
8	300	63	12.7	63	12.7	---	---	0	0.78	0.08	0	2.56	1.25	0.003	1.000	49	1.00?	0.00	0.0
8	400	63	12.7	63	12.7	---	---	0	0.78	0.08	0	1.00	1.40	0.004	1.000	87	1.00?	0.00	0.0

SUMMARY TABLE 2 - SELECTED MODIFIED ATT-KIN REACH ROUTINGS IN ORDER OF STANDARD EXECUTIVE CONTROL INSTRUCTIONS
(A STAR(*) AFTER VOLUME ABOVE BASE(IN) INDICATES A HYDROGRAPH TRUNCATED AT A VALUE EXCEEDING BASE + 10% OF PEAK
A QUESTION MARK(?) AFTER COEFF.(C) INDICATES PARAMETERS OUTSIDE ACCEPTABLE LIMITS, SEE PREVIOUS WARNINGS)

		HYDROGRAPH INFORMATION							ROUTING PARAMETERS									PEAK	
		INFLOW		OUTFLOW		OUTFLOW+ INTERV.AREA						Q AND A EQUATION						TRAVEL TIME	
XSEC ID	REACH LENGTH (FT)	PEAK (CFS)	TIME (HR)	PEAK (CFS)	TIME (HR)	PEAK (CFS)	TIME (HR)	BASE-FLOW (CFS)	VOLUME ABOVE BASE (IN)	MAIN TIME INCR (HR)	ITER-ATION #	COEFF (X)	POWER (M)	LENGTH FACTOR (K*)	PEAK RATIO O/I (Q*)	S/Q @PEAK (K) (SEC)	ATT-KIN COEFF (C)	STOR-AGE (HR)	KINE-MATIC (HR)
ALTERNATE		1	STORM	2															
8	1900	74	12.7	55	13.1	---	---	0	0.80	0.08	1	0.040	1.66	0.334	0.746	1440	0.18	0.24	0.42
14	1200	16	12.6	16	12.6	---	---	0	0.85	0.08	1	3.02	1.25	0.040	0.989	226	0.78?	0.08	0.06
14	3000	283	13.3	276	13.6	---	---	0	1.19	0.08	1	0.220	1.48	0.035	0.976	904	0.27	0.32	0.25
ALTERNATE		1	STORM	3															
3	1000	247	12.5	244	12.6	---	---	0	3.46	0.08	1	0.040	1.66	0.049	0.989	468	0.47	0.08	0.13
3	1400	162	12.5	158	12.7	401	12.6	0	3.46	0.08	1	0.040	1.66	0.112	0.974	775	0.31	0.08	0.22
6	1850	446	12.6	441	12.7	548	12.7	0	3.19	0.08	1	1.53	1.21	0.058	0.988	381	0.55	0.16	0.11
8	450	548	12.7	548	12.7	---	---	0	2.90	0.08	0	0.180	1.61	0.003	1.000	74	1.00?	0.00	0.00
5	1400	284	12.5	284	12.6	357	12.6	0	3.46	0.08	1	0.610	1.48	0.018	1.000	211	0.81?	0.08	0.06
8	1200	357	12.6	357	12.6	---	---	0	2.96	0.08	1	0.480	1.55	0.010	1.000	154	0.97?	0.08	0.04
4	1200	37	12.5	35	12.8	73	12.5	0	3.47	0.08	1	0.050	1.66	0.185	0.943	1047	0.24	0.08	0.29
5	1300	73	12.5	66	12.7	116	12.6	0	3.45	0.08	1	0.140	1.48	0.118	0.914	826	0.30	0.16	0.23
8	1100	116	12.6	115	12.6	---	---	0	2.61	0.08	1	1.76	1.25	0.026	0.992	216	0.80?	0.08	0.06
144	1400	36	12.5	23	13.1	53	12.6	0	1.83	0.08	1	0.050	1.48	0.822	0.626	2239	0.12	0.24	0.67
9	600	53	12.6	50	12.7	84	12.6	0	1.90	0.08	1	0.110	1.48	0.045	0.942	498	0.45	0.16	0.14
7	2000	84	12.6	70	13.0	162	12.6	0	1.92	0.08	1	0.160	1.48	0.161	0.830	1106	0.23	0.16	0.32
8	300	162	12.6	162	12.6	---	---	0	1.87	0.08	0	2.56	1.25	0.003	1.000	41	1.00?	0.00	0.00
8	400	162	12.6	162	12.6	---	---	0	1.87	0.08	0	1.00	1.40	0.003	1.000	67	1.00?	0.00	0.00
8	1900	172	12.6	146	13.0	---	---	0	1.90	0.08	1	0.040	1.66	0.184	0.852	1029	0.25	0.24	0.29
14	1200	35	12.6	35	12.6	---	---	0	1.98	0.08	1	3.02	1.25	0.030	0.998	194	0.85?	0.08	0.05
14	3000	400	13.4	396	13.8	---	---	0	2.39	0.08	1	0.220	1.48	0.018	0.990	808	0.30	0.32	0.22

SUMMARY TABLE 3 - DISCHARGE (CFS) AT XSECTIONS AND STRUCTURES FOR ALL STORMS AND ALTERNATES

XSECTION/ STRUCTURE ID	DRAINAGE AREA (SQ MI)	STORM NUMBERS..... 1	2	3
STRUCTURE 8	1.31			
ALTERNATE 1		11.16	133.05	249.74
XSECTION 1	0.15			
ALTERNATE 1		77.45	149.82	248.49
XSECTION 2	0.10			
ALTERNATE 1		52.48	100.45	165.73
XSECTION 3	0.29			
ALTERNATE 1		118.91	255.59	446.92
XSECTION 4	0.05			
ALTERNATE 1		19.41	40.65	72.56
XSECTION 5	0.10			
ALTERNATE 1		18.80	53.33	116.20
XSECTION 6	0.40			
ALTERNATE 1		128.46	298.76	548.07
XSECTION 7	0.22			
ALTERNATE 1		12.82	63.35	161.98
XSECTION 8	1.31			
ALTERNATE 1		66.81	550.06	1290.84
XSECTION 9	0.03			
ALTERNATE 1		4.77	16.53	35.95
XSECTION 10	0.03			
ALTERNATE 1		4.40	16.13	36.02
XSECTION 14	1.31			
ALTERNATE 1		142.32	276.22	395.90
XSECTION 16	0.12			
ALTERNATE 1		30.00	79.99	155.97
XSECTION 18	0.18			
ALTERNATE 1		18.39	73.81	171.98

SUMMARY TABLE 3 - DISCHARGE (CFS) AT XSECTIONS AND STRUCTURES FOR ALL STORMS AND ALTERNATES

XSECTION/ STRUCTURE ID	DRAINAGE AREA (SQ MI)	STORM NUMBERS..... 1	2	3
XSECTION 19	0.02			
ALTERNATE 1		12.02	22.96	37.85
XSECTION 144	0.07			
ALTERNATE 1		5.68	20.65	52.80

END OF 1 JOBS IN THIS RUN

APPENDIX II

HYDRAULIC DATA

HYDRAULIC COMPUTATIONS

1. Outlet Rating Curve for Sedimentation Basin

   (60" Storm-Drain, Diversion Pipe with Overflow Spillway)

2. Spillway channel

3. 60" Storm-Drain (Diversion Pipe) Hydraulics

4. 2-48" Culvert Outlet for Detention Basin at Beardsley Road

   a. Establish flow through 2-48" culvert outlet

   b. Establish tailwater depths for the channel south of Beardsley Road

   c. Culvert Performance Curve for 1-48" pipe

   d. Culvert Performance Curve for 1-48" pipe with restricted inlet through 36" opening

   e. Outlet Rating Curve

5. 36" Storm Drain (along Beardsley Road) Hydraulics

   a. Inlet hydraulics

   b. Tailwater impact on 36" pipe at its junction with 48" pipe

   c. 36" Storm Drain Hydraulics

6. Interim channel along north property line

Partially flow pipe carries more flow than full pipe. why 4.9' full pipe carries 125 cfs and 5.5' full pipe carries 140 cfs.

$A = .2739 * 5^2 = 6.85\ ft^2$

$R = .2061 * 5 = 1.03\ ft$

$Q = (1.486/.012) * 6.85 * 1.03^{2/3} * \sqrt{.00258}$

=

OUTLET RATING CURVE FOR SEDIMENT BASIN

60" Pipe Rating Curve Inlet Control				Spillway Rating Spillway Inv. - 1296.00			
Elev.	Controlling Depth	Basin HW	Capacity	Controlling H	Capacity	Total Capacity	Volume
1290.5	0	-	0	0	0	0	0
$\frac{d}{D}=0.38$	1.9 ft.	1292.4	~~25~~ cfs 32	0	0	25 cfs	2.8 Ac. Ft.
$\frac{d}{D}=0.56$	2.8	1293.3	~~50~~ 64.4 70	A = 9.07 R = 1.2 0	0	50	4.2
$\frac{d}{D}=0.70$	3.5	1294.0	~~75~~ 102 120	A = 14.68 R = 1.48 0	0	75	5.3
$\frac{d}{D}=0.84$	4.2	1294.7	~~100~~ 132 146	A = 17.6 R = 1.52 0	0	100	6.3
$\frac{d}{D}=0.98$	4.9	1295.4	~~125~~ 146 152	A = 19.54 R = 1.37 0	0	125	7.4
	5.5	1296.0	140 ok	0	0	140	8.3
	5.7	1296.2	150 ok	0.2 ft.	27 cfs	177	8.6
	7.3	1297.8	195 ok 175	1.23 ft 1.8	724	899	11.0
	9.0	1299.5	215 200	3.5	1964	2164	13.5

$Q_o = \frac{1.486}{n} A R^{2/3} S^{1/2}$, $n = .012$, $A = \frac{\pi (5)^2}{4} = 19.63$

$R = D/4 = 5/4 = 1.25$

$S = .00258\ 1/ft$

$= \frac{1.486}{.012} * 19.63 * 1.25^{2/3} \sqrt{.00258}$

$= 143.3$ cfs.

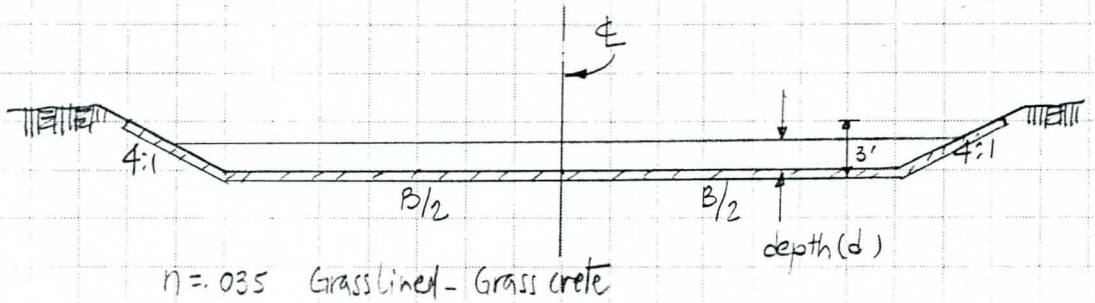
WOOD / PATEL ASSOCIATES
Civil Engineers
Hydrologists
Land Surveyors

PROJECT: Det. Basin 1
PROJECT NO.: 90541 SHEET NO. ____ OF ____
CALCULATED BY: tcp DATE: 10/4/91
CHECKED BY: ____ DATE: ____

SPILLWAY CHANNEL

Design Q_{100} = 1023 cfs ±

To satisfy the Parks Department for aesthetic requirements, numerous configuration of spillway alignment, channel linings were evaluated. A grass-crete lining was selected to meet these requirements and to minimize maintenance needs



n = .035 Grass lined - Grass crete
S = .0433 above pool elevation

Location	B	d	velocity	Capacity	Remarks
downstream of Spillway Crest	80'	1.23'	9.74	1023	Velocity acceptable ∵ < 15 Fps
mid point	65'	1.39	10.47	1023	-do-
@ West Basin Line	50'	1.45	12.57	1023	S = .0625 [illegible] velocity is expected to be lower due to high tailwater condition ∴ ok V < 15 Fps

ok! by using trimmings eq

$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$

$A = 50 \times 1.45 + 4 \times 1.45^2 = 80.91$ ft²

$Q = \frac{1023}{80.91} = 12.64$

$P = 50 + \sqrt{17(1.45)^2} = 55.98$

$R = \frac{80.91}{55.98} = 1.45$ ft

WOOD / PATEL ASSOCIATES
Civil Engineers
Hydrologists
Land Surveyors

PROJECT: Det. Basin 1
PROJECT NO.: 90541 SHEET NO. ____ OF ____
CALCULATED BY: AGP DATE: 9/28/91
CHECKED BY: ____ DATE: ____

60" STORM-DRAIN HYDRAULICS

Design Procedure:

1. Establish controlling water surface elevation at the junction box
   a. check channel tailwater
   b. check critical depth in 48" pipe
   c. establish controlling outlet condition (see sht.)

   d. Since open channel flow controlled the 48" pipe, use mannings

2. Perform standard step backwater calculation using "Dodson" software (see sht.) for the 60" Φ

   Stations for 60" Φ are based on station = 0 at the junction box
   Stationing increase upstream

3. Check condition at the 60" pipe inlet, Sediment Basin.

   High water in pipe per Dodson = 1494.78
   therefore, assumption of inlet control for Rating curve (60") calculation is valid.

STORM SEWER LINE AND LOCATION	PIPE DIA. (IN.)	REACH LENGTH (FT.)	SLOPE OF REACH (FT./FT.)	INVERT ELEV. (FT.)	DESIGN DISCHARGE (CFS.)	FULL PIPE DISCHARGE (CFS.)	DEPTH OF FLOW (FT.)	ACTUAL VELOCITY (FPS.)	ACTUAL VELOCITY HEAD (FPS.)	HEAD LOSSES FRICTION H_f (FT.)	HEAD LOSSES SHOCK OR FORM ΔH (FT.)	SLOPE OF ENERGY GRADE (FT./FT.)	GRADE LINE ELEV. ENERGY	GRADE LINE ELEV. HYDRAULIC	REMARKS
channel-outlet															
Drop South of Beardsley		-0-	.0005	1485.29	150	(C4) 150	3.4	1.55	.033	-0-	-0-		1488.71	1488.67	Starting water surface
2-48" outlets @	48"	5	N/A	1487.59	150/2 = 75	75	d_c=2.62*	8.6	1.15	-0-	-0-		1488.71	1487.57	Controlling elevation,
Beardsley Road,															
2-48", Inlet	48"	92	.002177	1487.77	150/2 = 75	75	3.41	6.57	.67	0.2	-		1492.05	1491.38	Junction Box

CIRCULAR CHANNEL ANALYSIS
NORMAL DEPTH COMPUTATION

September 27, 1991
Park Basin #1
48" pipe analysis

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second).....	75.0
Channel Bottom Slope (feet per foot).....	0.0022
Manning's Roughness Coefficient (n-value).....	0.0120
Channel Diameter (feet).....	4.00

PROGRAM RESULTS:

DESCRIPTION	VALUE
Normal Depth (feet).....	3.41
Flow Velocity (feet per second).....	6.57
Froude Number (Flow is Sub-Critical).....	0.577
Velocity Head (feet).....	0.67
Energy Head (feet).....	4.08
Cross-Sectional Area of Flow (square feet).....	11.41
Top Width of Flow (feet).....	2.84

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(713) 895-8322. A complete program manual is available.

CIRCULAR CHANNEL ANALYSIS
CRITICAL DEPTH COMPUTATION

September 27, 1991
Park Basin #1
48" pipe analysis

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second).....	75.0
Manning's Roughness Coefficient (n-value).....	0.0120
Channel Diameter (feet).....	4.00

PROGRAM RESULTS:

DESCRIPTION	VALUE
Critical Depth (feet).....	2.62
Critical Slope (feet per foot).....	0.0040
Flow Velocity (feet per second).....	8.60
Froude Number.....	1.000
Velocity Head (feet).....	1.15
Energy Head (feet).....	3.77
Cross-Sectional Area of Flow (square feet).....	8.73
Top Width of Flow (feet).....	3.80

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CIRCULAR CHANNEL ANALYSIS
STANDARD STEP WATER SURFACE PROFILE

September 27, 1991
Park Basin #1
60" pipe Back Water Analysis
Hydraulic & Energy Grade Line Calculations

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second).....	150.0
Channel Bottom Slope (feet per foot).....	0.0026
Manning's Roughness Coefficient (n-value).....	0.0120
Channel Diameter (feet).....	5.00
Channel Flow-Line Elevation at Starting Station (feet)..	1487.87
Water Surface Elevation at Starting Station (feet).....	1491.38
Starting Channel Station (feet).....	0.00

PROGRAM RESULTS:

DESCRIPTION	VALUE
Normal Depth (feet).....	4.35
Critical Depth (feet).....	3.51

Station (ft)	Flowline (ft)	WS Elev. (ft)	Depth (ft)	Flow Area (sq ft)	Vel (fps)	Velocity Head(ft)	EGL Slope (ft/ft)
0.0	1487.87	1491.38	3.51	14.73	10.18	1.610	0.004000
26.0	1487.94	1491.68	3.74	15.77	9.51	1.405	0.003413
189.0	1488.36	1492.39	4.03	16.95	8.85	1.216	0.002918
448.0	1489.03	1493.19	4.17	17.48	8.58	1.143	0.002747
882.0	1490.15	1494.41	4.26	17.83	8.41	1.099	0.002651
1019.0	1490.50	1494.78	4.28	17.89	8.39	1.092	0.002637

CIRCULAR CHANNEL ANALYSIS COMPUTER PROGRAM, Version 1.5 (c) 1986
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(713) 895-8322. A complete program manual is available.

CIRCULAR CHANNEL ANALYSIS
RATING CURVE COMPUTATION

September 27, 1991
Park Basin #1
60" Storm Drain Diversion Pipe
Conveys flow from Sediment Basin to Channel South of Beardsley

---

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Channel Bottom Slope (feet per foot).....	0.0026
Manning's Roughness Coefficient (n-value).....	0.0120
Channel Diameter (feet).....	5.00

PROGRAM RESULTS:

Depth (ft)	Flow Rate (cfs)	Velocity (fps)	Froude Number	Velocity Head(ft)	Energy Head(ft)	Flow Area (sq ft)	Top Width (ft)
1.0	12.6	4.49	0.947	0.313	1.313	2.80	4.00
2.0	48.3	6.59	0.949	0.674	2.674	7.33	4.90
3.0	96.3	7.83	0.871	0.952	3.952	12.30	4.90
4.0	140.1	8.32	0.715	1.075	5.075	16.84	4.00
4.3	150.1	8.28	0.628	1.064	5.414	18.13	3.36

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(713) 895-8322. A complete program manual is available.

CIRCULAR CHANNEL ANALYSIS
CRITICAL DEPTH COMPUTATION

September 27, 1991
Park Basin #1
60" Storm Drain Diversion Pipe
Conveys flow from Sediment Basin to Channel South of Beardsley

---

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second).....	150.0
Manning's Roughness Coefficient (n-value).....	0.0120
Channel Diameter (feet).....	5.00

PROGRAM RESULTS:

DESCRIPTION	VALUE
Critical Depth (feet).....	3.51
Critical Slope (feet per foot).....	0.0040
Flow Velocity (feet per second).....	10.18 ?
Froude Number.....	1.000
Velocity Head (feet).....	1.61
Energy Head (feet).....	5.12
Cross-Sectional Area of Flow (square feet).....	14.73
Top Width of Flow (feet).....	4.57

check Vc.

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(713) 895-8322. A complete program manual is available.

If $F = 1$, $\frac{V_c}{\sqrt{g y_c}} = 1$

$V_c = \sqrt{g y_c}$

$= \sqrt{(32.2)(3.51)}$

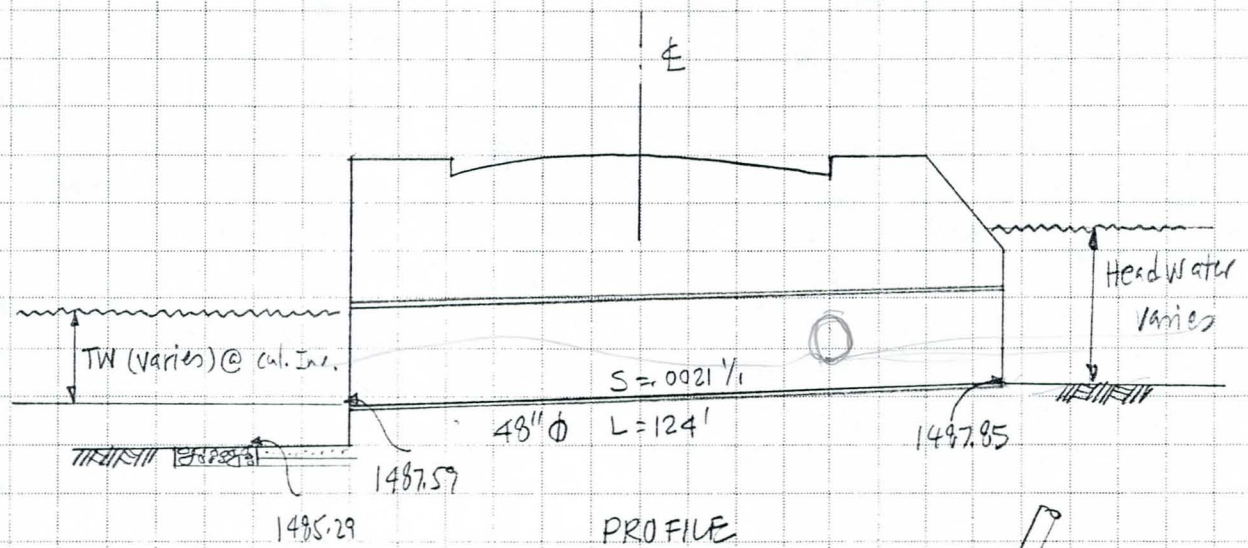
$= \sqrt{113.02}$

$V_c = 10.63$ ft/sec.

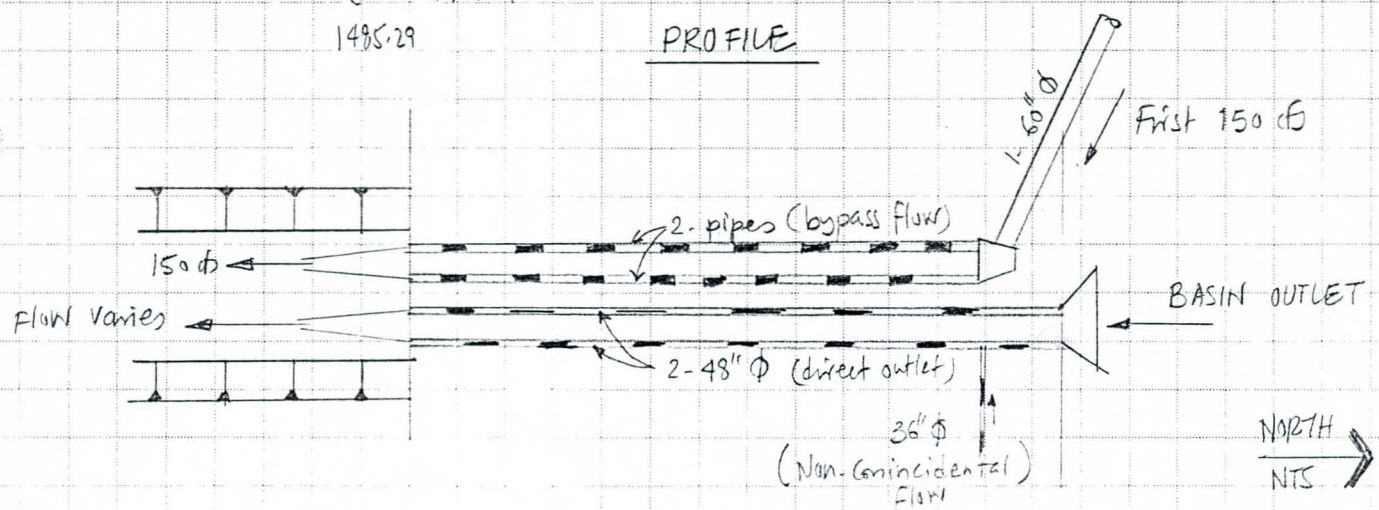
WOOD / PATEL ASSOCIATES
Civil Engineers
Hydrologists
Land Surveyors

PROJECT: Det. Basin 1
PROJECT NO.: 90541 SHEET NO. ____ OF ____
CALCULATED BY: ACP DATE: 9/26/91
CHECKED BY: ____ DATE: ____

Culvert @ Beardsley, Outlet Rating Curve Computations



PROFILE



PLAN

Tailwater Depth above pipe outlet	Channel Capacity	Flow Contribution 1-60" ϕ	Flow Contribution from 2-48"/Basin	Total Culvert Flow	Direct outlet (cfs) (For rating curve calculation for each 48")
0	0	0	0	0	0
.4 ft	96.8 cfs	96.8 cfs	0 cfs	96.8 cfs	0 cfs
1.4	188.3	150.0	38.3	188.3	19.15
2.4	319.0	150.0	169.0	319.0	84
3.4	490.9	150.0	340.9	490.9	170.4
4.4	711.5	150.0	561.5	711.5	280.7
5.4	984.5	150.0	834.5	984.5	417.2

you can't have this because the HW > 9

TRAPEZOIDAL CHANNEL ANALYSIS
RATING CURVE COMPUTATION

September 26, 1991
Park Basin #1
Culvert at Beardsley Road
Outlet Tailwater Condition to check culvert Performance

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Channel Bottom Slope (feet per foot).....	0.0005
Manning's Roughness Coefficient (n-value).....	0.0350 (Riprap Apron)
Channel Side Slope - Left Side (horizontal/vertical)....	5.00
Channel Side Slope - Right Side (horizontal/vertical)...	5.00
Channel Bottom Width (feet).....	12.0

PROGRAM RESULTS:

TAIL-WATER Elev.	Depth (ft)	Flow Rate (cfs)	Velocity (fps)	Froude Number	Velocity Head(ft)	Energy Head(ft)	Flow Area (sq ft)	Top Width (ft)	TAILWATR DEPTH From PIPE Outlet Inv. 1487.59
1486	0.7	7.6	0.67	0.153	0.007	0.737	11.4	19.3	–
1487	1.7	38.4	1.08	0.172	0.018	1.748	35.7	29.3	–
1488	2.7	96.8	1.38	0.183	0.030	2.760	70.0	39.3	.4
1489	3.7	188.3	1.65	0.191	0.042	3.772	114.3	49.3	1.4
1490	4.7	318.0	1.89	0.197	0.055	4.785	168.6	59.3	2.4
1491	5.7	490.8	2.11	0.203	0.069	5.799	232.9	69.3	3.4
1492	6.7	711.5	2.32	0.207	0.083	6.813	307.2	79.3	4.4
1493	7.7	984.5	2.51	0.212	0.098	7.828	391.5	89.3	5.4

TRAPEZOIDAL CHANNEL ANALYSIS COMPUTER PROGRAM, Version 1.3 (c) 1986
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(713) 895-8322. A manual with equations & flow chart is available.

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

September 26, 1991
Park Basin #1
Performance Curve for 1-48" culvert Outlet @ Beardsley Road
There are two 48" pipes directly discharging in to Channel

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Diameter (feet).....	4.00
FHWA Chart Number (1,2 or 3).....	1
Scale Number on Chart (Type of Culvert Entrance).....	2
Manning's Roughness Coefficient (n-value).....	0.0120
Entrance Loss Coefficient of Culvert Opening.....	0.50
Culvert Length (feet).....	124.1
Culvert Slope (feet per foot).....	0.0021

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
19.1	1.40	1.77	2.46	1.42	1.29	1.40	4.89
51.6	1.90	3.15	3.35	2.52	2.16	2.16	7.47
84.0	2.40	4.39	4.53	4.00	2.78	2.78	9.02
127.2	2.90	5.95	6.64	4.00	3.38	3.38	11.23
170.4	3.40	8.33	9.37	4.00	3.73	3.73	13.97

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Checked using Culvert Program

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

October 1, 1991
Park Basin #1
Try 1-36" inlet for the East 48" pipe

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Diameter (feet).....	3.00
FHWA Chart Number (1,2 or 3).....	1
Scale Number on Chart (Type of Culvert Entrance).....	2
Manning's Roughness Coefficient (n-value).....	0.0120
Entrance Loss Coefficient of Culvert Opening.....	0.50
Culvert Length (feet).....	124.1
Culvert Slope (feet per foot).....	0.0061 *

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
19.1	1.40	2.00	1.70	1.20	1.40	1.20	7.21
51.6	1.90	3.78	3.78	2.25	2.34	2.34	8.74
84.0	2.40	6.34	7.10	3.00	2.80	2.80	12.22
127.2	2.90	11.68	13.59	3.00	2.96	2.96	18.04

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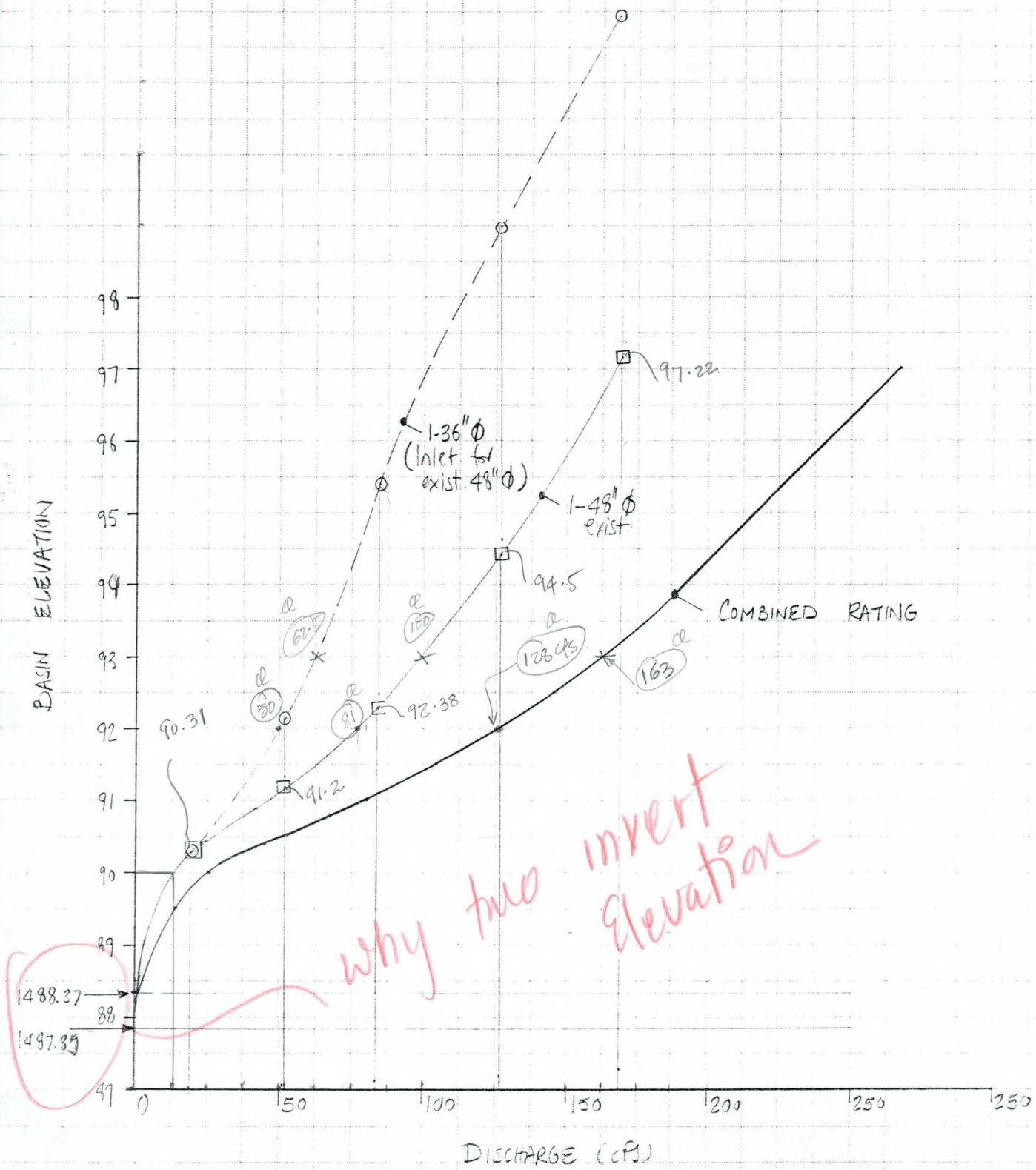
* $\text{slope} = \frac{(1487.85+0.5) - 1487.59}{124.1} = .0061 \text{ FT/FL}$

WOOD / PATEL ASSOCIATES
Civil Engineers
Hydrologists
Land Surveyors

PROJECT: Det. Basin 1
PROJECT NO.: 9541 SHEET NO. ____ OF ____
CALCULATED BY: HP DATE: 10/1/91
CHECKED BY: ____ DATE: ____

OUTLET RATING CURVE - 2-48" Pipes



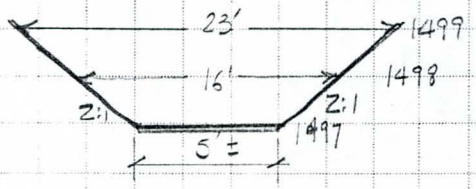
WOOD / PATEL ASSOCIATES
Civil Engineers
Hydrologists
Land Surveyors

PROJECT: Det. Basin 1
PROJECT NO.: 90541 SHEET NO. ____ OF ____
CALCULATED BY: tcp DATE: 9/29/91
CHECKED BY: ____ DATE: ____

Inlet Condition @ Station 37+88 Beardsley Road, 36" inlet

Design Q_{100} = 36 cfs

1. Approach channel

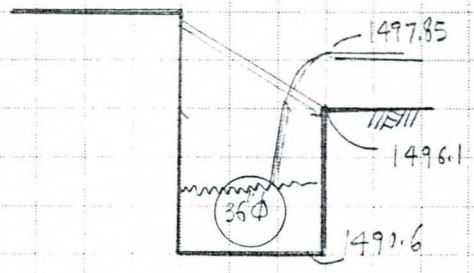


Slope = $\frac{1520-1500}{2500}$ = .008 %

n = .035

Cap. @ d = 1', Z = 3.2:1 Cap = 24.6 cfs, V = 3 fps
d = 1.2 = 36 cfs V = 3.2 fps (∴ ok)

2. Inlet, (weir condition)



weir flow, $Q = CLH^{3/2}$
$36 = 3 \times 5.2 \times H^{3/2}$ or H = 1.75'

3. Inlet, (Pipe orifice) Use FHWA, HEC-5 for culvert inlet condition (chart 2, Grove end w/ headwall)

HW/D = 0.9 ∴ HW required = 0.9 x 3.0 = 2.7'

HW elev. = 1490.5 + 2.7 = 1493.3 < 1496.1 ∴ ok

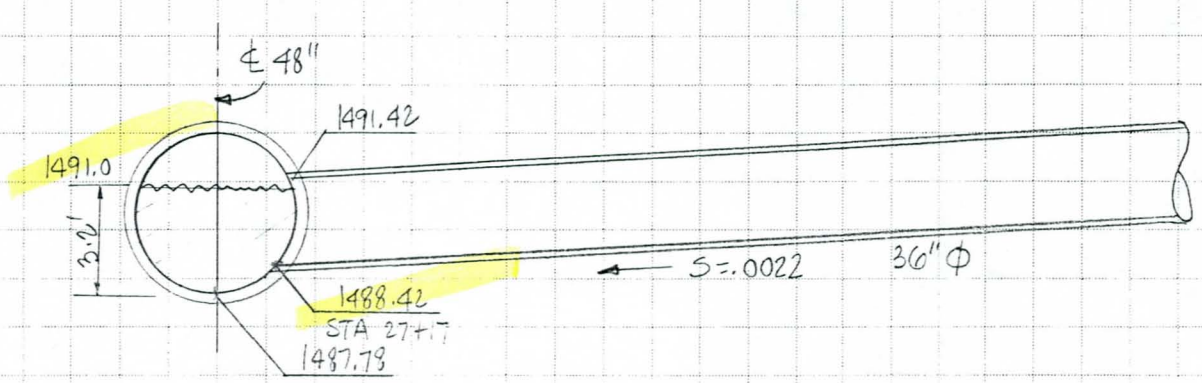
WOOD / PATEL ASSOCIATES
Civil Engineers
Hydrologists
Land Surveyors

PROJECT: Det. Basin 1
PROJECT NO.: 90541 SHEET NO. ____ OF ____
CALCULATED BY: ATP DATE: 9/28/91
CHECKED BY: ____ DATE: ____

36" PIPE @ BEARDSLEY ROAD

Hydraulics

Since this pipe conveys flow from a relatively small subarea, it is assumed that its outlet into the 48" culvert will not create significant backwater during the peak flow (within 36" pipe).



Design Q_{in} = 36 cfs

Capacity of 48", for depth = 3.2' ≈ 70 cfs ∴ ok

CIRCULAR CHANNEL ANALYSIS
RATING CURVE COMPUTATION

October 1, 1991
Park Basin 1
1-48" Pipe Outlet at Beardsley Road
Impact Of Connection with 36" Pipe

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Channel Bottom Slope (feet per foot).....	0.0021
Manning's Roughness Coefficient (n-value).....	0.0120
Channel Diameter (feet).....	4.00

PROGRAM RESULTS:

Depth (ft)	Flow Rate (cfs)	Velocity (fps)	Froude Number	Velocity Head(ft)	Energy Head(ft)	Flow Area (sq ft)	Top Width (ft)
0.3	0.6	1.68	0.723	0.044	0.294	0.33	1.94
0.5	2.4	2.62	0.789	0.107	0.607	0.91	2.65
0.8	5.5	3.36	0.819	0.175	0.925	1.63	3.12
1.0	9.8	3.98	0.832	0.245	1.245	2.46	3.46
2.0	35.7	5.67	0.798	0.500	2.500	6.28	4.00
3.0	65.0	6.43	0.664	0.642	3.642	10.11	3.46
3.5	74.9	6.43	0.539	0.641	4.141	11.66	2.65
3.8	76.7	6.27	0.439	0.610	4.360	12.24	1.94

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Depth = 3.8, $\frac{d}{D} = \frac{3.8}{4} = 0.95$, $A = 0.7707 * 4^2 = 12.33$
$HR = 0.2864 * 4 = 1.15$

$Q = \frac{1.486}{.012} \times 12.33 * (1.15)^{2/3} \times \sqrt{.0021} = \underline{76.8 \text{ cfs}}$

Depth = 2.0 $\frac{d}{D} = \frac{2.0}{4} = 0.5$, $A = .3927 * 4^2 = 6.28$
$HR = 0.2500 * 4 = 1.00$

$Q = \frac{1.486}{.012} \times 6.28 \times (1)^{2/3} \times \sqrt{.0021} = \underline{35.64 \text{ cfs}}$

CIRCULAR CHANNEL ANALYSIS
STANDARD STEP WATER SURFACE PROFILE

October 16, 1991
DETENTION BASIN #1
36" PIPE ALONG BEARDSLEY ROAD
STATION 2717 IS AT THE 48" PIPE JUNCTION

==========

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second).....	36.0
Channel Bottom Slope (feet per foot).....	0.0022
Manning's Roughness Coefficient (n-value).....	0.0120
Channel Diameter (feet).....	3.00
Channel Flow-Line Elevation at Starting Station (feet)..	1488.42
Water Surface Elevation at Starting Station (feet).....	1491.00
Starting Channel Station (feet).....	2717.00

==========

PROGRAM RESULTS:

DESCRIPTION	VALUE
Normal Depth (feet).....	2.68
Critical Depth (feet).....	1.95

Station (ft)	Flowline (ft)	WS Elev. (ft)	Depth (ft)	Flow Area (sq ft)	Vel (fps)	Velocity Head(ft)	EGL Slope (ft/ft)
2717.0	1488.42	1491.00	2.58	6.47	5.57	0.481	0.002299
3070.0	1489.20	1491.82	2.62	6.55	5.50	0.470	0.002255

==========

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$2.67 + \frac{20 \cdot 12}{(6.55)^2} =$

CIRCULAR CHANNEL ANALYSIS
STANDARD STEP WATER SURFACE PROFILE

October 16, 1991
DETENTION BASIN #1
36" PIPE ALONG BEARDSLEY ROAD
STATION 2717 IS AT THE 48" PIPE JUNCTION

==========

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second).....	36.0
Channel Bottom Slope (feet per foot).....	0.0018
Manning's Roughness Coefficient (n-value).....	0.0120
Channel Diameter (feet).....	3.00
Channel Flow-Line Elevation at Starting Station (feet)..	1489.20
Water Surface Elevation at Starting Station (feet).....	1491.80
Starting Channel Station (feet).....	3070.00

==========

PROGRAM RESULTS:

DESCRIPTION	VALUE
Normal Depth (feet).....	3.30
Critical Depth (feet).....	1.95

Station (ft)	Flowline (ft)	WS Elev. (ft)	Depth (ft)	Flow Area (sq ft)	Vel (fps)	Velocity Head(ft)	EGL Slope (ft/ft)
3070.0	1489.20	1491.80	2.60	6.51	5.53	0.475	0.002275
3500.0	1489.97	1492.80	2.83	6.91	5.21	0.422	0.002146

==========

CIRCULAR CHANNEL ANALYSIS COMPUTER PROGRAM, Version 1.5 (c) 1986
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CIRCULAR CHANNEL ANALYSIS
STANDARD STEP WATER SURFACE PROFILE

October 16, 1991
DETENTION BASIN #1
36" PIPE ALONG BEARDSLEY ROAD
STATION 2717 IS AT THE 48" PIPE JUNCTION

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second).....	36.0
Channel Bottom Slope (feet per foot).....	0.0021
Manning's Roughness Coefficient (n-value).....	0.0120
Channel Diameter (feet).....	3.00
Channel Flow-Line Elevation at Starting Station (feet)..	1489.99
Water Surface Elevation at Starting Station (feet).....	1492.80
Starting Channel Station (feet).....	3500.00

PROGRAM RESULTS:

DESCRIPTION	VALUE
Normal Depth (feet).....	3.30
Critical Depth (feet).....	1.95

Station (ft)	Flowline (ft)	WS Elev. (ft)	Depth (ft)	Flow Area (sq ft)	Vel (fps)	Velocity Head(ft)	EGL Slope (ft/ft)
3500.0	1489.99	1492.80	2.81	6.88	5.23	0.425	0.002145
3788.0	1490.59	1493.42	2.83	6.90	5.21	0.422	0.002146

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WOOD / PATEL ASSOCIATES
Civil Engineers
Hydrologists
Land Surveyors

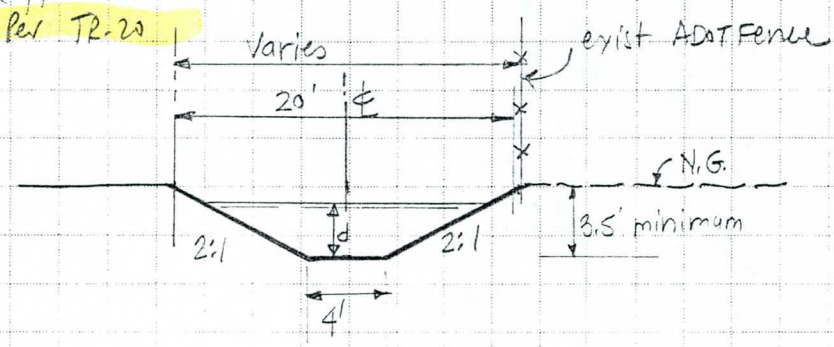
PROJECT: Det. Basin 1
PROJECT NO.: 90541 SHEET NO. ____ OF ____
CALCULATED BY: Acp DATE: 9/24/91
CHECKED BY: ____ DATE: ____

Channel along north property line

Per City of Phoenix, design flow of 10-year can be used since this channel is to collect & convey the flow to sediment basin for the interim condition.

Ultimately, ADOT is to design & built a diversion structure north of ADOT R/W, to discharge into sediment basin.

$Q_2 = 13$ cfs Per TR-20
$Q_5 = 40$ cfs Per TR-20
$Q_{10} = 60$ cfs (approximated)
$Q_{100} = 160$ cfs Per TR-20



SECTION X-X

Since channel will have a short term use, use $n = .025$ (unlined in dirt)
Slope = .002 ft/ft

depth (d)	Capacity	velocity	Remarks	
2.5'	7.3 cfs	3.45 fps	Cap > Q_{10} ∴ OK	velocity - acceptable
3.5'	160 cfs	4.16 fps	(No freeboard)	vel < 5 fps .. OK

Mannings $Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$

$= \frac{1.49}{.025} * 38.5 * 3.3^{2/3} * \sqrt{.002}$

$Q = 227$ cfs

$A = 4 * 3.5 + \frac{1}{2}(2 * 3.5 * 3.5) * 2 = 38.5$

$P = 4 + \sqrt{3.5^2 + (2 * 3.5)^2} = 11.83$ ft

$R = \frac{38.5}{11.83} = 3.3$ ft

APPENDIX III

DETENTION VOLUME DATA

DETENTION BASIN STORAGE VOLUME COMPUTATIONS 18-Oct-91

VOLUME COMPUTATION
DETENTION BASIN 1

PROJECT NO 90541

Elevation	Acres	Eff. dept	Ac. ft.	Cumu. Vol.
1487.84	0.000	0	0	0
1488	0.144	0.16	0.012	0.012
1489	1.618	1	0.881	0.893
1490	6.275	1	3.947	4.839
1491	9.953	1	8.114	12.953
1492	10.653	1	10.303	23.256
1493	11.950	1	11.302	34.558
1494	12.368	1	12.159	46.717
1495	12.802	1	12.585	59.302
1496	13.233	1	13.018	72.319
1497	15.000	1	14.117	86.436

APPENDIX IV

SEDIMENT ANALYSIS DATA

SEDIMENT YIELD

Conclusions based on Sediment Computations:

1. Sediment production rate/yield is anticipated to be about 0.2 Ac. Ft./sq. mile/year based on a full urbanized condition.

   The rate will be impacted due to construction activity, antecedent moisture condition, and a condition of drainage conveyance system.

2. Sediment basin is anticipated to be very effective for more frequent flows generally occurring during low moisture conditions within the drainage area.
   e.g. 1-year, 2-year, 5-year Storms

   For storm events such as 10-year, 25-year, 50-year and 100-year some sediments including: Fire sand
   Silt
   Clay

   will be trapped by the basin park. However, since these are less frequent events, impact to the park will be very moderate on a long term basis.

3. Sediment basin should be cleared on a 5-year basis or immediately after a major storm event (Precip. > 1.5" - 2"), whichever occurs first.

Sediment Yield Computations:

Based on investigations by the U.S. Army Corps of Engineers, and S.C.S., natural watershed in similar environment could produce sediments in a range 0.2 to 0.5 Ac. Ft./sq. mile/year.

It has been noted, however, that in an Urban Condition, sediment production is reduced to insignificantly low amounts.

It is assumed that for the subject basin, sediment yield will be about 0.2 Ac. Ft./sq. mile/year.

Total Sediment Yield/Year = 0.2 x 1.7 = .35 Ac. Ft. (Average Yearly)

Assuming trap efficiency = 80%, sediment deposition = 0.27 Ac. Ft.

For basin bottom area = 1.8 Ac.
deposition depth = 0.27/1.8 = .15'/Year

Deposition per 5-year = 0.76' (Average rainfall condition)
10-year = 1.52' (Average rainfall condition)

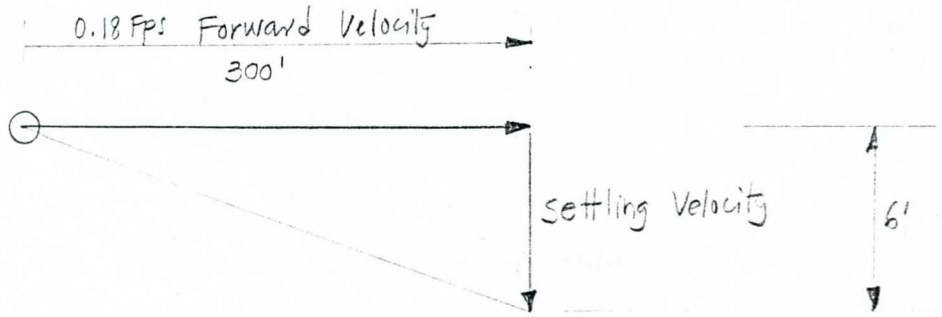
It is recommended that the debris basin be cleared at least on a 5-year interval or after a major storm event, whichever occurs first.

Check Effectiveness of Sediment Basin

Parameters: (1) Q_2 = 250 cfs (AMC II)
Basin Area = 1.8 Ac
Pipe diversion = 60", Capacity = 150 cfs
Q_2 outlet due to storage effect - 200 cfs
Flooding depth = 6', Basin Length = 300'

$$\text{Ave. Velocity thru basin} = \frac{200 \text{ cfs}}{200' \text{ (width)} \times 5.5' \text{ (depth)}}$$

$$= 0.18 \text{ fps}$$



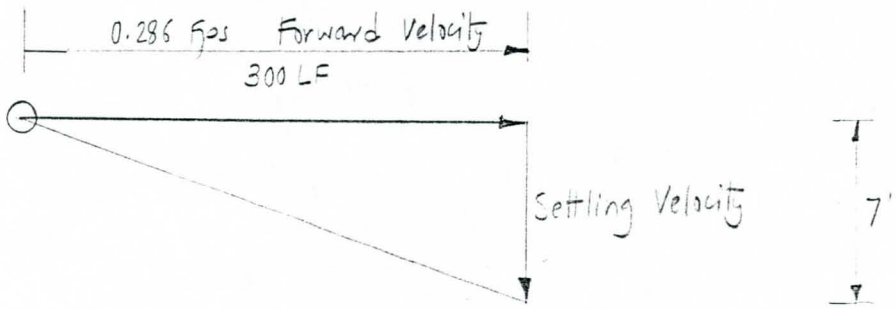
$$\text{Setting Velocity} = \frac{\text{Forward Velocity}}{\text{Length of Basin}} = \frac{0.18}{300}$$

$$= 0.0006 \text{ fps}$$

From chart on Page 5/5, therefore, the basin will effectively be trapping majority of particles greater than 0.005 mm (Silt).

(2) Q_5 = 458 cfs (AMC II)
In reality this value could be less due to dry soil conditions
Q_5 = 241 cfs (AMC II)

Basin Area = 1.8 Ac (Ponding area)
Pipe diversion = 150 cfs (60" pipe)
Effective Flow = 400 cfs (due to storage effect)
Flooding depth = 7.0'
Basin Length = 300'



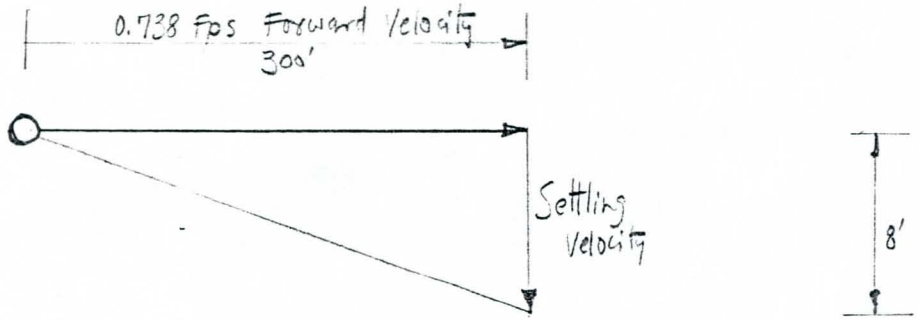
$$\text{Ave. Velocity thru basin} = \frac{400 \text{ cfs}}{200 \times 7} = 0.286 \text{ fps}$$

$$\text{Settling Velocity} = \frac{\text{Forward Velocity}}{\text{Basin Length}} = \frac{0.286}{300} = .00095 \text{ fps}$$

From Chart on page 5/5, therefore, the debris basin will trap majority of particles greater than very fine sand and some silt.

(3) Q_{100} = 1180 cfs (AMC II)

Basin Area = 1.8 Ac (Ponding area)
Pipe diversion = 150 cfs (60" pipe)
Effective Flow = 1180 cfs
Flooding depth = 8.0'
Basin Length = 300'

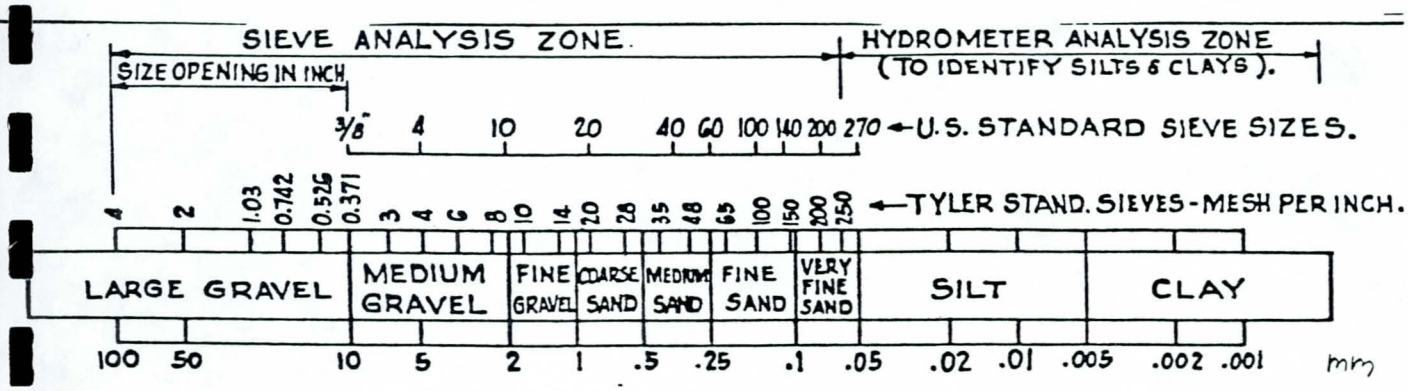


$$\text{Ave. Velocity thru basin} = \frac{1180 \text{ cfs}}{200 \times 7} = 0.738 \text{ fps}$$

$$\text{Settling Velocity} = \frac{0.738}{300} = .00246 \text{ fps}$$

From Chart on page 5 of 5, therefore, the debris basin will trap majority of particles greater than fine sand and some very fine sand.

In a major event such as this, the park basin will receive some deposition of very fine sand, some silt and clay.

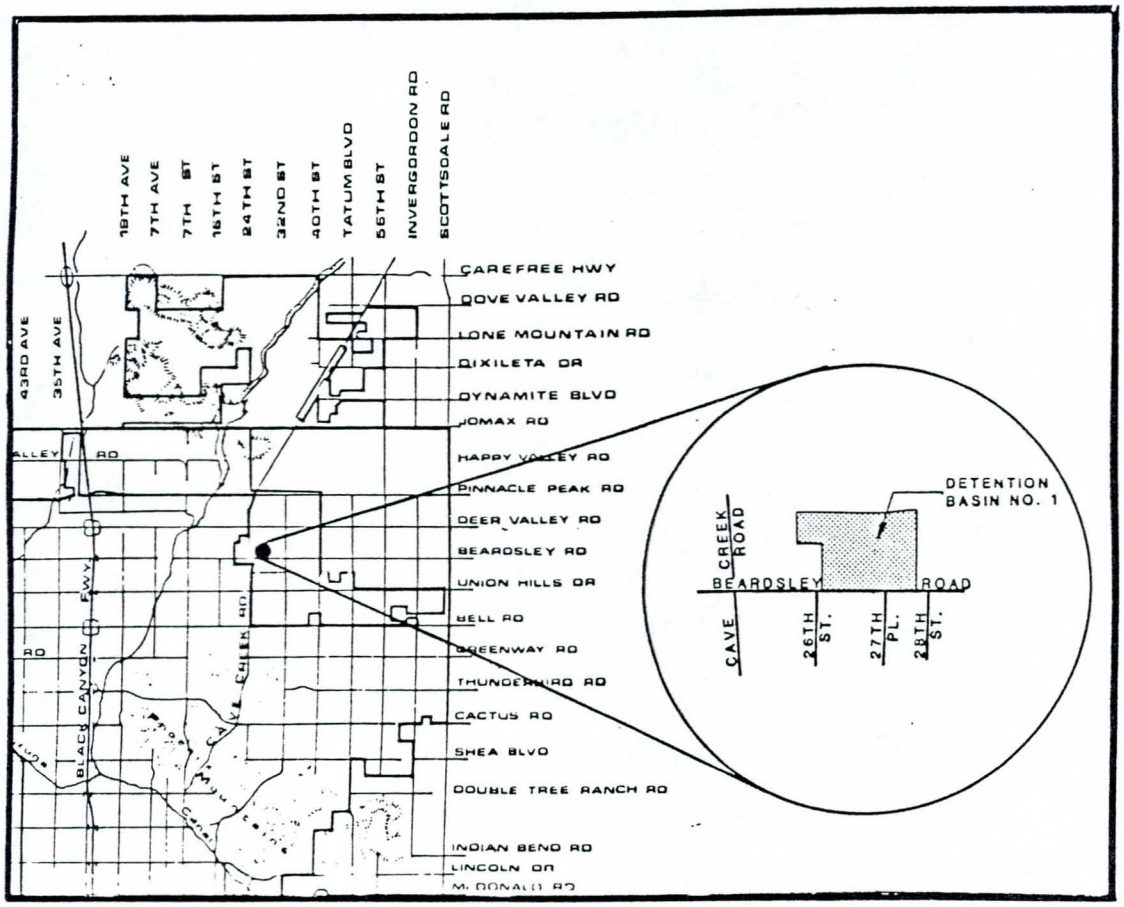


Settling Velocity	in/min	330	170	54	16	4	-	.2	.04
	fps	.45	.24	.08	.022	.0056		.00028	.000056

Ref. Seelye 9-10, 19-06

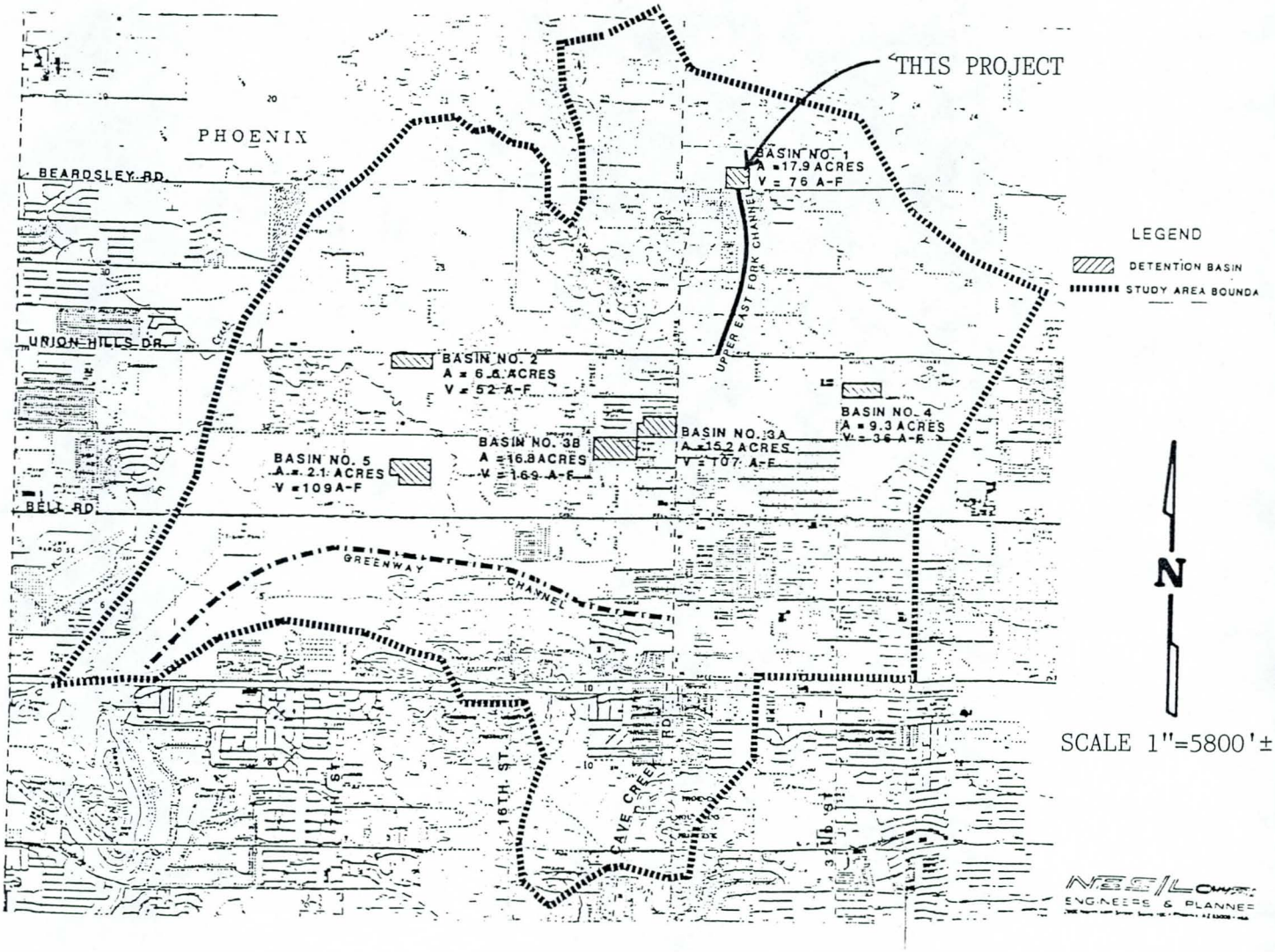
Appendix V

List of Figures



SCALE 1"=6 m

LOCATION MAP
DETENTION BASIN NO. 1
ST-896811
FIGURE 1



STUDY AREA & DETENTION BASIN LOCATIONS
UPPER EAST FORK OF CAVE CREEK
AREA DRAINAGE MASTER STUDY

FIGURE 2

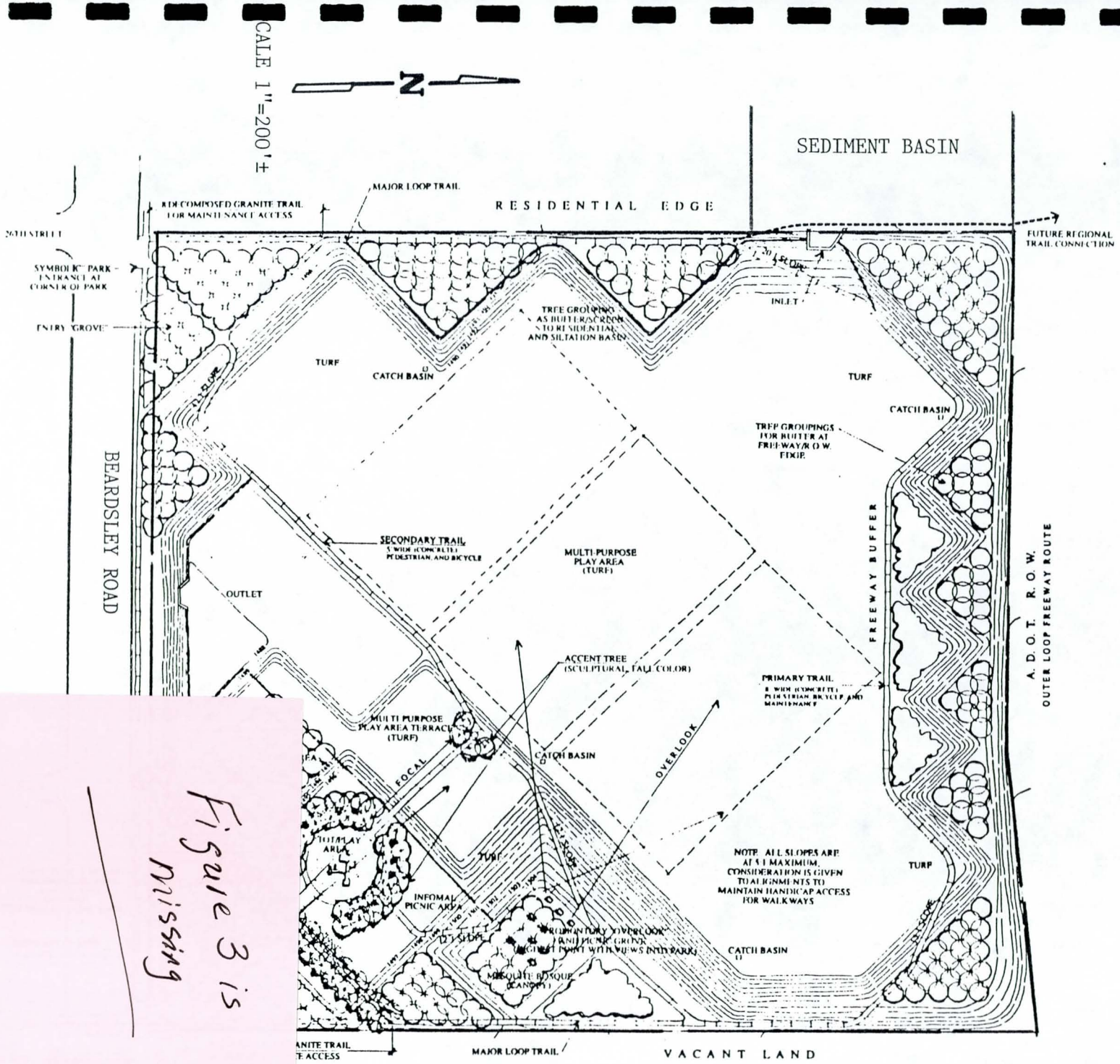
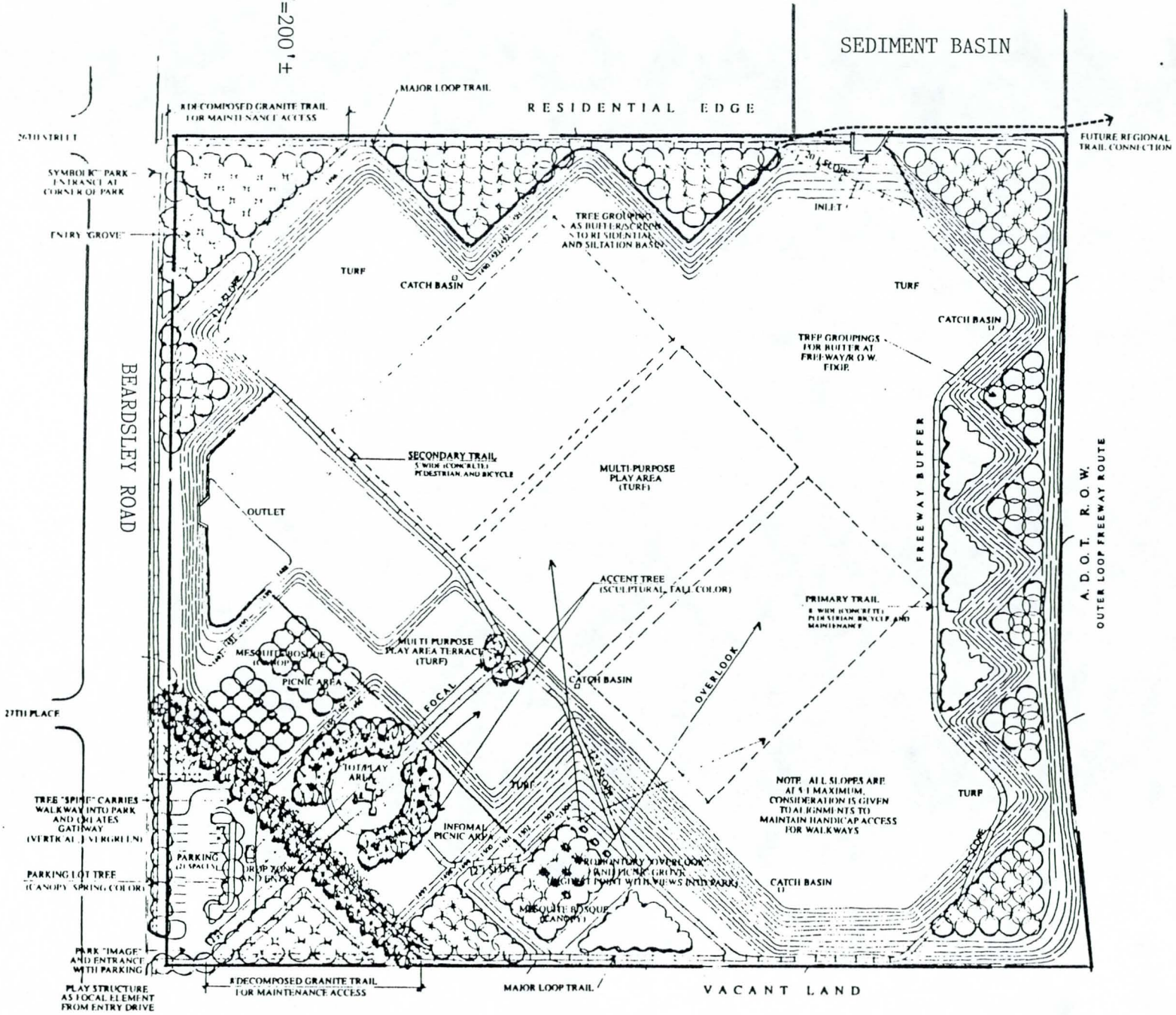
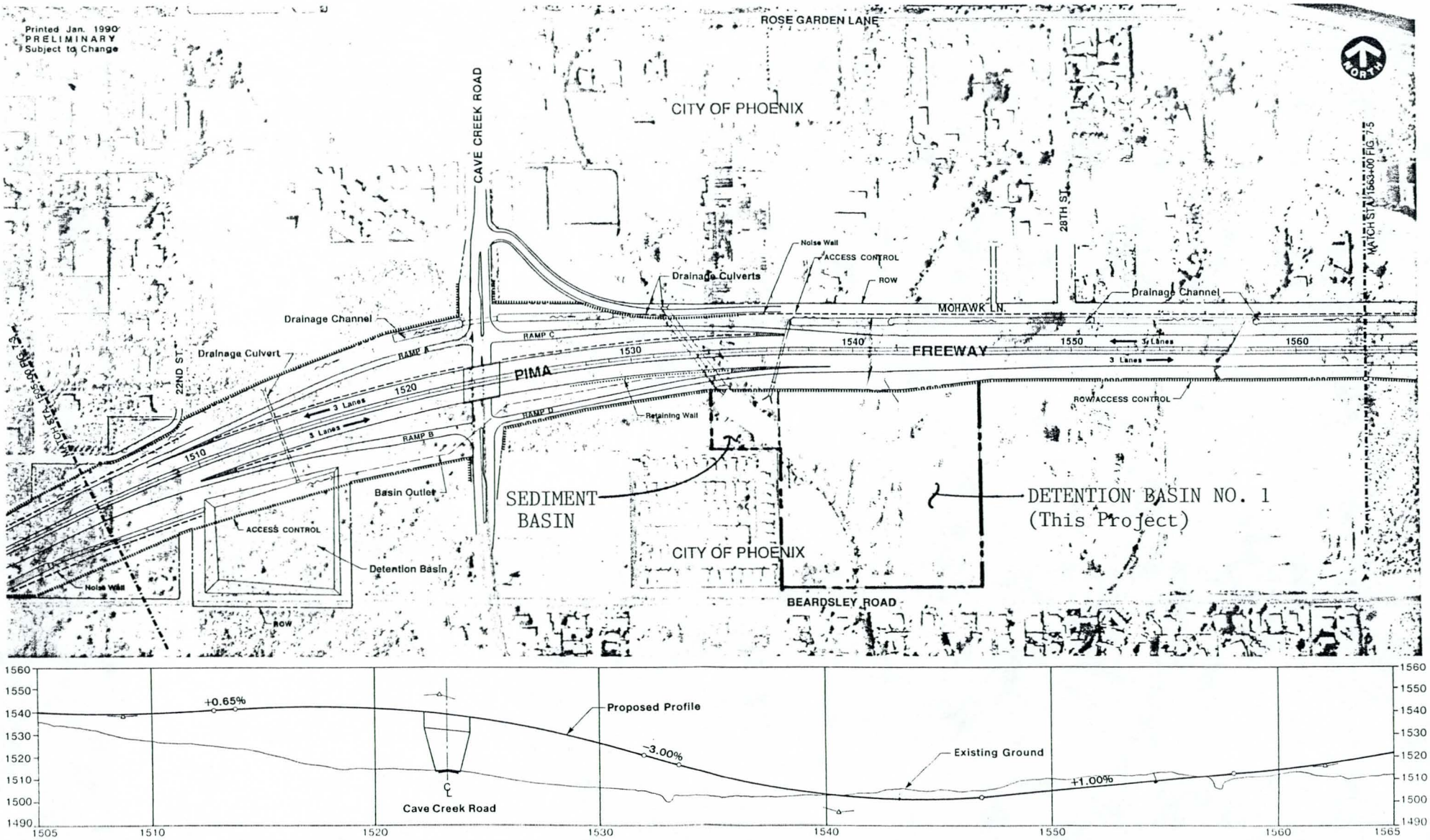


Figure 3 is missing

PARK MASTER PLAN
FIGURE 4



BASIN/PARK
PARK MASTER PLAN
FIGURE 4



Loop 101

prepared by DeLeuw, Cather & Company, Management Consultant for the

ARIZONA DEPARTMENT OF TRANSPORTATION

SCALE IN FEET

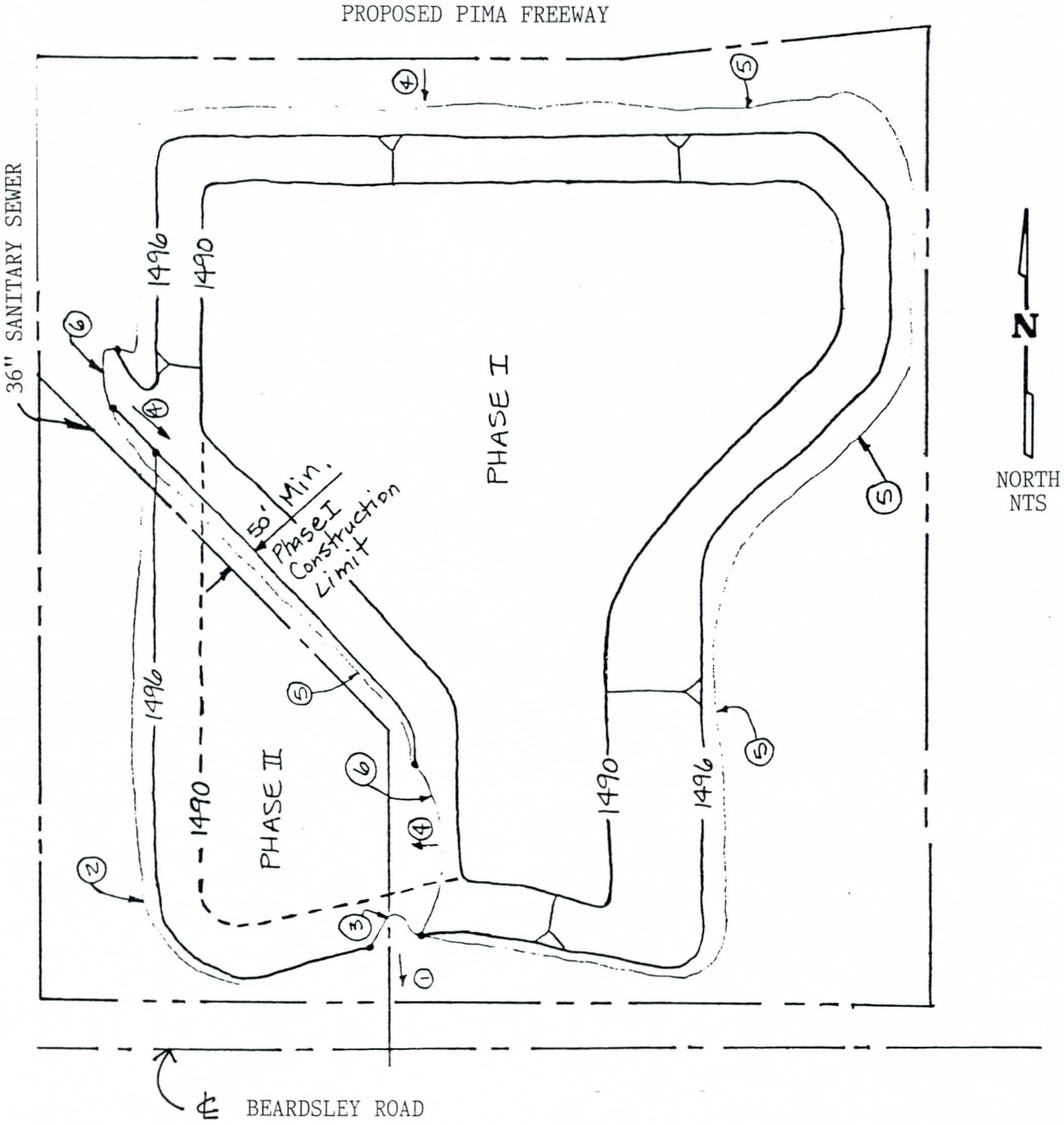
VERTICAL 0 40 80 120

HORIZONTAL 0 400 800 1200

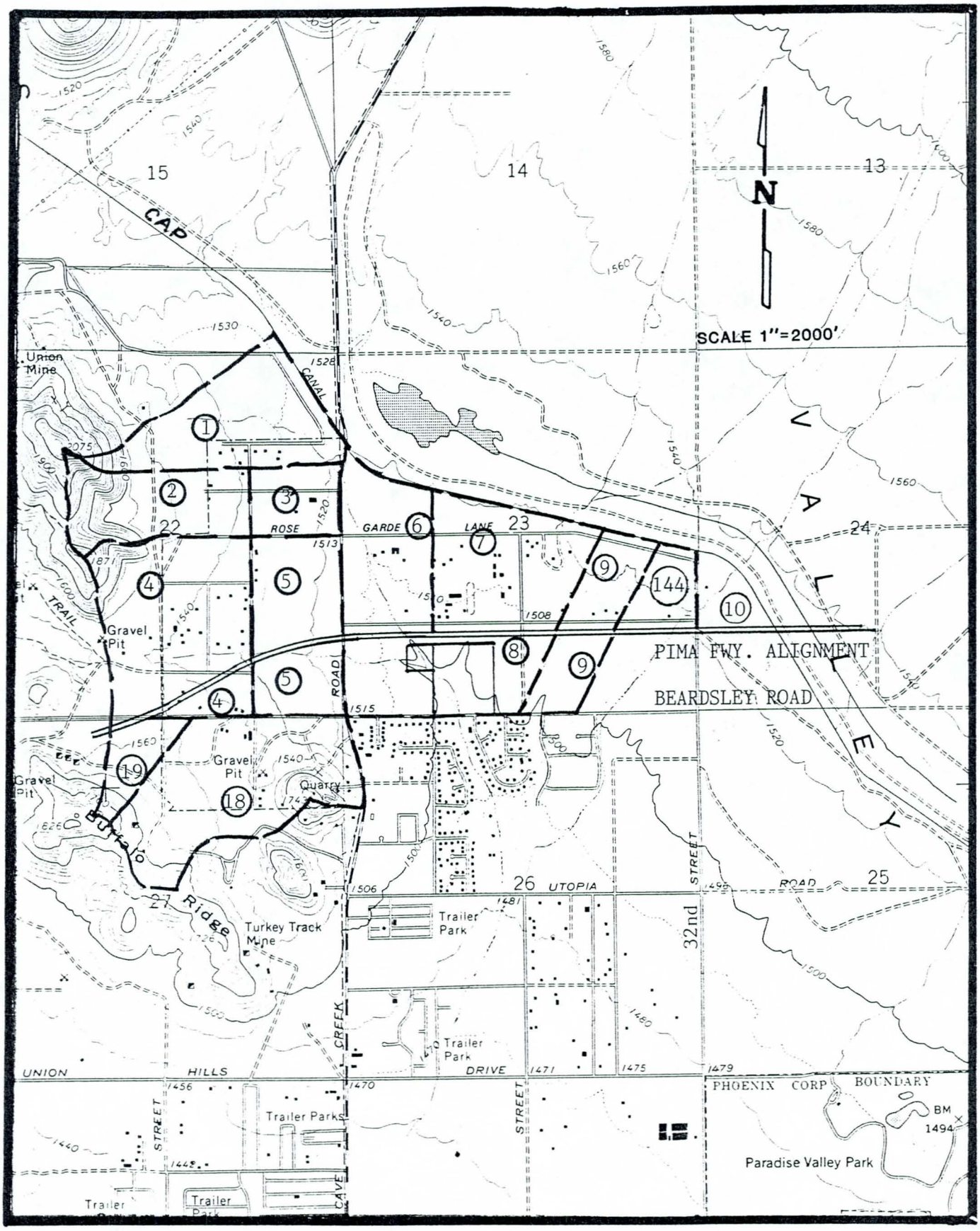
CAVE CREEK ROAD INTERCHANGE

ADOT - CONCEPTUAL DRAINAGE SCHEME

FIGURE 5



ROUGH GRADING PLAN
DETENTION BASIN NO. 1
ST-896811
FIGURE 6

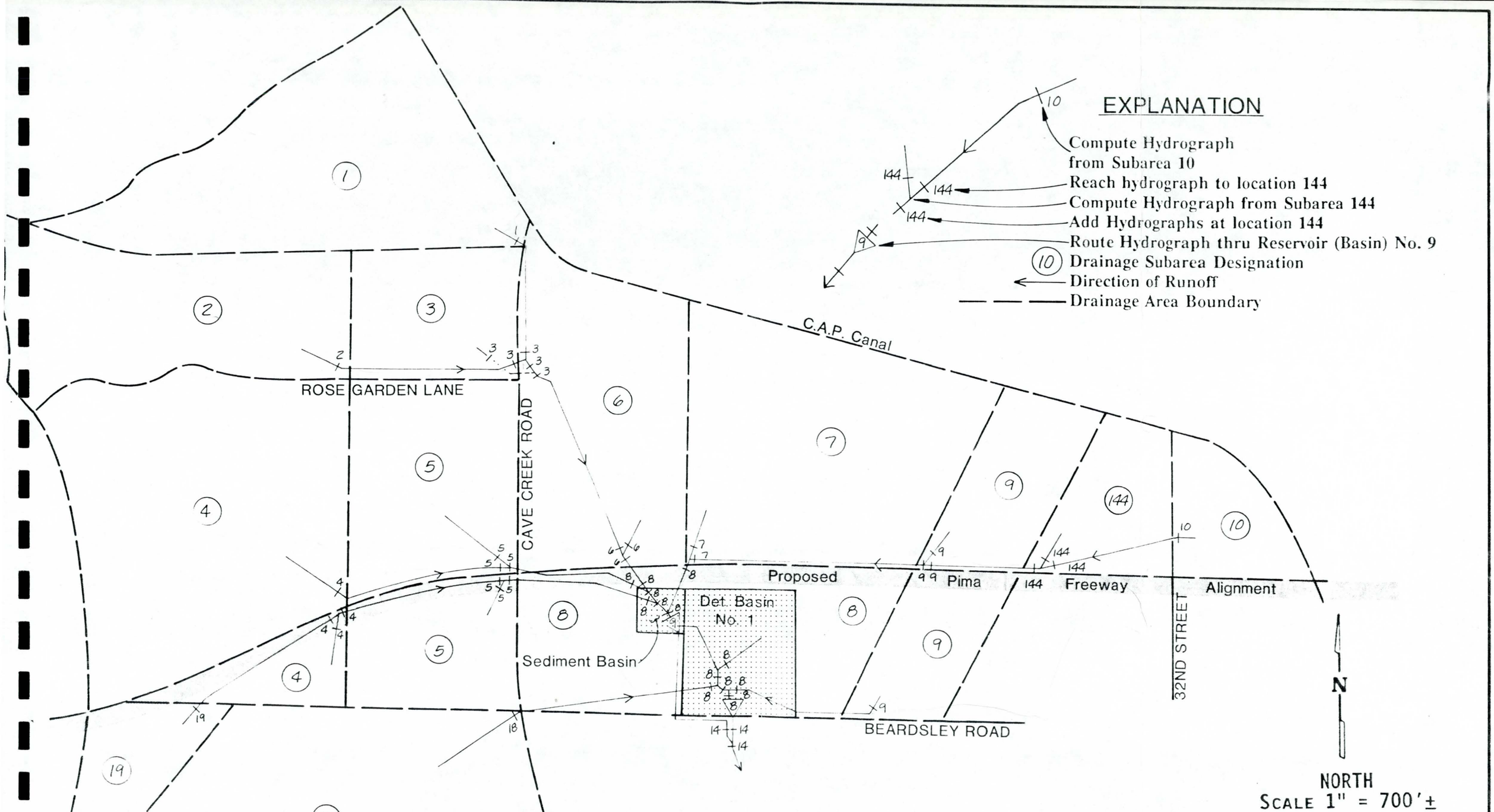


LEGEND

—— DRAINAGE AREA BOUNDARY

① DRAINAGE AREA DESIGNATION

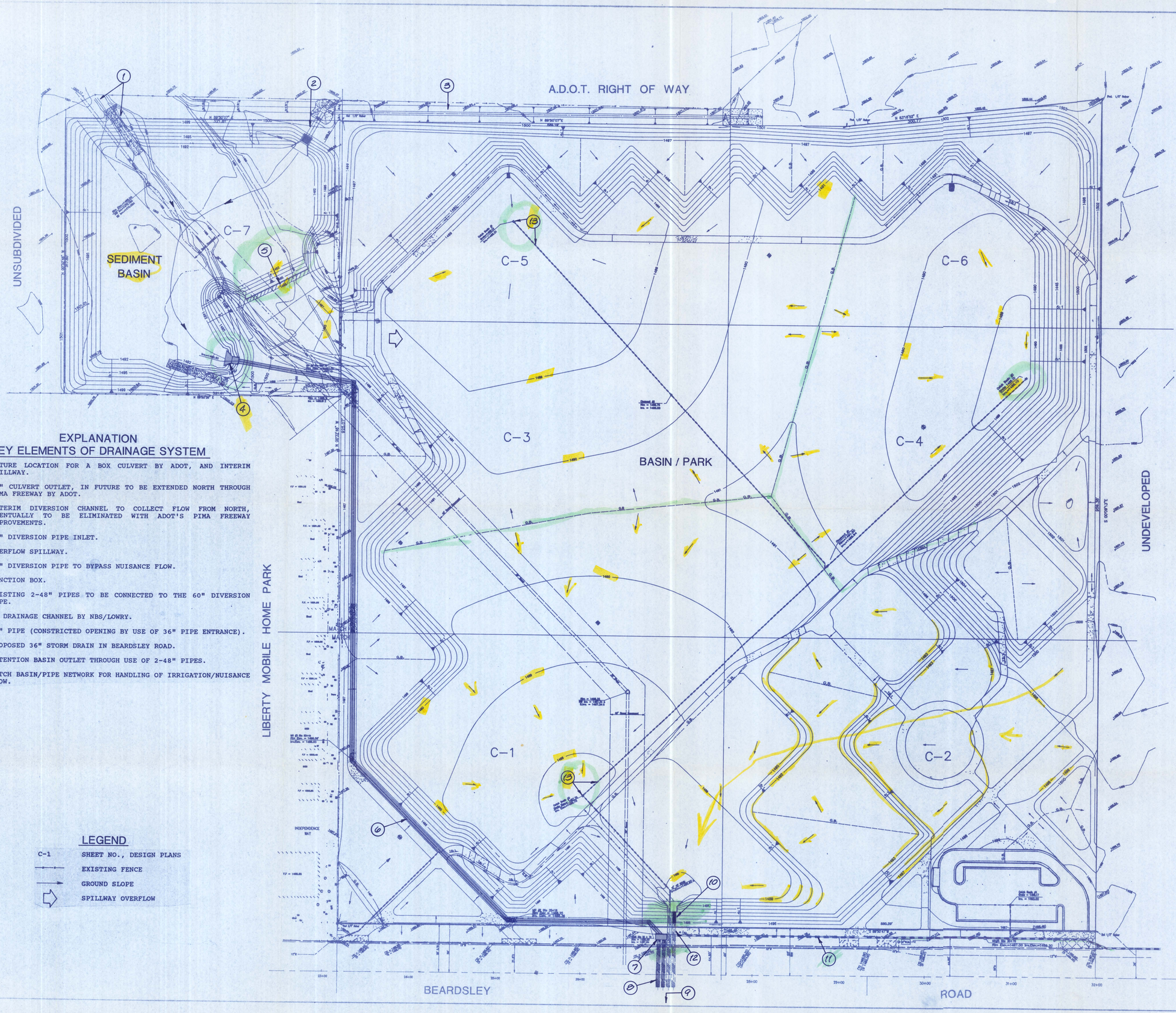
DRAINAGE AREA MAP
DETENTION BASIN NO. 1
ST-896811
FIGURE 7



NOTE: location identification numbering system has been dictated by an Area Wide Drainage Master Plan prepared for the Flood Control District of Maricopa County. This has resulted in reusing the same ID Number numerous times.

TR-20 SCHEMATIC DIAGRAM
DETENTION BASIN NO. 1
ST-896811
WP #90541

FIGURE 8



EXPLANATION
KEY ELEMENTS OF DRAINAGE SYSTEM

1. FUTURE LOCATION FOR A BOX CULVERT BY ADOT, AND INTERIM SPILLWAY.
2. 72" CULVERT OUTLET, IN FUTURE TO BE EXTENDED NORTH THROUGH PIMA FREEWAY BY ADOT.
3. INTERIM DIVERSION CHANNEL TO COLLECT FLOW FROM NORTH, EVENTUALLY TO BE ELIMINATED WITH ADOT'S PIMA FREEWAY IMPROVEMENTS.
4. 60" DIVERSION PIPE INLET.
5. OVERFLOW SPILLWAY.
6. 60" DIVERSION PIPE TO BYPASS NUISANCE FLOW.
7. JUNCTION BOX.
8. EXISTING 2-48" PIPES TO BE CONNECTED TO THE 60" DIVERSION PIPE.
9. TO DRAINAGE CHANNEL BY NBS/LOWRY.
10. 48" PIPE (CONSTRICTED OPENING BY USE OF 36" PIPE ENTRANCE).
11. PROPOSED 36" STORM DRAIN IN BEARDSLEY ROAD.
12. DETENTION BASIN OUTLET THROUGH USE OF 2-48" PIPES.
13. CATCH BASIN/PIPE NETWORK FOR HANDLING OF IRRIGATION/NUISANCE FLOW.

LEGEND

C-1	SHEET NO., DESIGN PLANS
	EXISTING FENCE
	GROUND SLOPE
	SPILLWAY OVERFLOW

Revisions	Date

Seal

Designed By:

Drawn By:

Checked By:

Date:

Title: **DETENTION BASIN NO. 1**
DRAINAGE SCHEME
ST-896811

FIGURE 3

CITY OF PHOENIX • ENGINEERING DEPARTMENT • DESIGN DIVISION